SAPIENZA
UNIVERSITÀ DI ROMA

Faculty of Economics

Department of Economics and Law

Doctoral School of Economics 26th Edition

ESSAYS ON HUMAN CAPITAL AND THE GROWTH OF ITALIAN CITIES

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December 2014

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NON-TECHNICAL SUMMARY (in Italian)

Con questa tesi si intende presentare una serie di nuovi risultati relativamente ad una grandezza a cui si è dedicata minore attenzione negli studi sull'Italia, ma che allo stesso tempo rappresenta l'ambiente nel quale quotidianamente vive e opera la maggior parte degli agenti economici: la città. Oggi più che in passato le città sono vive, vegete e in continua trasformazione. Sempre più, il benessere della nostra vita dipende dalla conoscenza di come funzionano e di come vanno gestite al meglio le aree urbane che abitiamo, per affrontare le crisi economiche, i conflitti sociali e la crescita culturale. Per questa ragione viene naturale chiedersi perché le città esistono, perché esse crescono o declinano, perché alcune città crescono più di altre. Queste sono le domande cui abbiamo cercato di rispondere nel presente lavoro il quale offre un'inedita storia economica delle aree urbane italiane nei primi 150 anni di unità nazionale. La prospettiva storica insieme ai più recenti strumenti di analisi economica rappresenta un'alchimia essenziale per afferrare le debolezze presenti e i punti di forza delle città così come interpretarne i cambiamenti subiti e anticiparne l'evoluzione futura.

La tesi è costituita da 3 papers.

Il primo lavoro "**Humal Capital and the Growth of Cities: A Literature Review**" è una rassegna della letteratura. Partendo da Romer (1986), il quale, inserendo all'interno dell'impianto teorico di crescita neoclassico l'idea di learning by doing e knowledge spillovers, riesce ad ottenere crescita perpetua e di conseguenza a spiegare la mancata convergenza tra le economie nazionali, si arriva a Lucas (1988) il quale enfatizza il ruolo delle città nel favorire il trasferimento di conoscenza tra agenti economici che operano a stretto contatto. Le idee si muovono più velocemente nelle aree urbane, dove individui inizialmente isolati si incontrano e scambiano idee. Quindi le esternalità cui la letteratura di crescita si riferisce è un carattere peculiare dell'ambiente urbano piuttosto che di sistemi economici aggregati e più dispersi. Nel processo di accumulazione di conoscenza, il ruolo e il peso delle città è quindi inevitabile.

A questo punto, il problema diventa misurare tali esternalità. Segue uno sterminato numero di lavori. Il punto di partenza è Rauch (1991), il quale usando il modello di equilibrio spaziale teorizzato da Roback (1982), mostra che le aree metropolitane con un livello di capitale umano più elevato registrano anche costi degli immobili e salari maggiori. Glaeser and Saiz (2004), Shapiro (2006), Glaeser et *al.* (2011) e Simon e Nardinelli (2002) sono gli studi più significativi su questa linea di ricerca per le città americane. Per il caso italiano possiamo citare Paci e Usai (2001), Deidda et al. (2002), Dalmazzo e de Blasio (2005, 2011) e Di Addario e Patacchini (2008).

Il secondo lavoro "**Growth in Italian Cities**" è di fatto il corpo della tesi. Oltre a fornire un excursus storico sull'evoluzione della popolazione e dell'occupazione nelle città italiane dall'Unificazione fino agli anni 2000 e a mostrare alcuni fatti stilizzati che saranno utilizzati come linee-guida nel corso del lavoro, lo scopo principale è valutare il ruolo che il capitale umano ha assunto nell'incentivare la crescita occupazionale nelle aree urbane. In particolare, si testano due canali. Il primo sostiene che la connessione istruzione-crescita sia generata da incrementi di produttività. In città con una più alta concentrazione di capitale umano si crea più innovazione e quindi crescita. Una spiegazione alternativa è che gli spillovers del capitale umano siano cresciuti nel corso del tempo. Queste due ipotesi sono empiricamente indistinguibili poiché entrambi prevedono uno spostamento del parametro tecnologico della funzione di produzione.

Il secondo canale ipotizza che la relazione capitale umano-crescita derivi dalla capacità delle persone skilled di generare amenities (maggiori opportunità di shopping, miglior qualità del luogo di lavoro o ancora amenità culturali, quali teatri, musei e cosi via) e di migliorare la qualità della vita nelle città in cui risiedono e attraverso questo canale incentivare la crescita occupazionale. Infatti, poiché le imprese tendono a delocalizzare fuori dai confini urbani o addirittura nazionali, il successo delle città dipende sempre più dal loro ruolo quali centri di consumo più che di produzione.

Utilizzando un modello di equilibrio spaziale *à la* Shapiro (2006), i risultati possono essere così riassunti: dal 1971 al 2001, le città con più capitale umano sono cresciute di più. Un incremento del 10 percento nella quota iniziale di individui in possesso di una laurea è associato con un incremento dell'occupazione dello 0,8 percento. Questo risultato vale sia livello di Sistema Locale del Lavoro (LLM) che a livello di città. La connessione capitale umano-crescita occupazionale è spiegata per la maggior parte dal canale "produttività" a livello di LLM, mentre le esternalità di consumo assumono un ruolo rilevante a livello di città. In questo ultimo caso la crescita nella qualità della vita spiega tra il 31 e il 43 percento della relazione istruzione-crescita occupazionale.

Sfruttando l'indagine sui bilanci delle famiglie italiane (SHIW), si dimostra anche come il capitale umano permetta alle città di ristrutturare la loro economia nel caso in cui siano colpite da shock avversi, come nel caso del Nord-Ovest. Infine testiamo un'ipotesi di gentrificazione. Il punto è che, condizionatamente al nostro campione di città, il capitale umano predice la crescita occupazionale e il declino della popolazione. Inserendo nel modello preferenze eterogenee tra individui skilled e unskilled, emerge una prima evidenza che una sorta di gentrificazione a livello di città possa essere avvenuta tra il 1970 e il 2000.

L'innovazione rispetto a Dalmazzo e de Blasio (2005, 2011) e Di Addario e Patacchini (2008) sono molteplici: a) il presente lavoro indaga la crescita dell'occupazione e della popolazione non i loro livelli statici; b) si testano numerose ipotesi che emergono da fatti stilizzati che coprono 150 anni di storia; c) utilizziamo due livelli di analisi, LLM e città.

"**Brain Gain in the Age of Mass Migration**" è il terzo lavoro. Esso indaga sulle origini del capitale umano nelle città Italiane. In questo studio si mostra come l'emigrazione di massa che si è sperimentata in Italia nella prima decade del XX secolo abbia ridotto l'abbandono scolastico (misurato dal tasso di frequenza nella scuola elementare) aumentando il livello di scolarizzazione in un Paese ancora poco industrializzato e a forte vocazione agricola quale appunto era l'Italia. Tre meccanismi sono alla base della relazione migrazione-scolarizzazione. Primo, la prospettiva migratoria o semplicemente l'emigrazione stessa potrebbero aver aumentato il rendimento atteso dell'istruzione e di conseguenza rendere l'investimento in istruzione più appetibile; secondo, la migrazione di ritorno avrebbe favorito la frequenza scolastica sia attraverso canali monetari (investimenti che effettuavano i migranti una volta tornati grazie ai risparmi accumulati all'estero) che non monetari (colui che ritornava era una persona trasformata dall'esperienza migratoria in grado di affrontare e valutare in modo diverso questioni sociali, culturali e politiche). Terzo, le rimesse avrebbero alleviato il vincolo di bilancio delle famiglie il quale rappresentava sicuramente un ostacolo all'investimento in istruzione.

Basandoci su una robusta evidenza qualitativa, su un nuovo dataset a livello di città e sull'analisi cliometrica (IV and GMM), i nostri risultati supportano la tesi secondo la quale la frequenza scolastica sarebbe stata positivamente correlata con (e probabilmente causata da) l'emigrazione e l'emigrazione di ritorno. Anche le rimesse sembrano essere positivamente associate con la scolarizzazione. Nello specifico, i nostri calcoli suggeriscono che ogni 100 persone in più che emigravano, riducevano il drop-out da 3 a 5 individui, mentre ogni 100 ritorni lo riducevano da 5 a 9 individui.

Humal Capital and the Growth of Cities: A Literature Review

Francesco Giffoni*

Abstract

This study summarizes the state of knowledge on the relationship between human capital and the growth of cities. We classify the research on this topic into three broad blocks: (1) the micro-macro debate over human capital and the role of cities, (2) the contingencies that have spur city growth in American urban areas with a focus on education, (3) the Italian case. We provide an extensive sight on the growth process of the Italian cities, from the Middle Age until the present days. The general message of this review is that human capital is the key to economic progress and cities play a major role in facilitating the accumulation of knowledge spillovers in the growth process.

Keywords: human capital, spatial spillover, city growth.

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1. Introduction

In the last 20 years the new endogenous growth theory has increasingly influenced the economic growth literature. It emphasizes the role played by human capital accumulation in boosting growth through stimulating technological creation and invention, eventually leading to increased productivity. However, the empirical estimations of the impact of human capital on economic growth have achieved mixed results.

Mainstream economics consists primarily of two levels of analysis— the 'micro' and the 'macro' level. The micro literature has produced several estimates of the monetary returns to education. One branch of literature focus on the Mincerian human capital model, according to which a change in a country's average level of schooling is one of the key determinants of its income growth. However this literature emphasizes private monetary returns to education at the expense of social returns. In this study we focus on the importance of physical proximity to the expansion of knowledge and as consequence the role of cities in growth must be considered. This led to the development of macro growth literature which has been motivated by the possible existence of positive social externalities of education which may exceed or fall short of private returns.

There are two main debates in the macro growth literature: the traditional growth models of Solow and Swan (1956), Cass (1965), and Koopmans (1965) and the new endogenous growth theories. While the former disregards human capital, the later incorporates it. In the traditional growth models physical capital drives growth. They are based on the crucial assumption of diminishing marginal returns to capital, which leads the growth process of an economy to eventually arrive at the steady state where the rate of technological progress is exogenously given. Whereas in the new endogenous growth models, human capital occupies a central role in spurring growth as knowledge spillovers and human capital externalities aid in delaying the tendency for diminishing returns to capital accumulation (Romer, 1986, Barro and Sala-i-Martin, 2004).

After a widely discussion on the macro and micro level debate of human capital and the role of cities in spurring knowledge, we deeply study the empirical evidence for the American and the Italian cases.

2. Growth, human capital and the role of cities: the macro approach.

According to current thinking and research in economics, geography and social science broadly, one of the most important driver of local economic development is highly skilled and educated people - what economists and social scientists frequently refer to as human capital. Places that have more of it thrive, while those with less stagnate or decline. As a consequence it is expected that if the stock of graduates in an area will increase then the region's long-run growth rate will increase as well. This is the case at both national and sub-national levels. But, let's proceed in the right order.

Since Solow (1956), it has seemed clear that the growth of economies does not involve the simple accumulation of capital and labor. A treatment of growth based entirely on capital and labor accumulation could not adequately explain why countries did not converge to a steady state over the long-run. Only by including an exogenous rate of technological change could economic models generate the perpetual growth that one seems to see in the developed countries, but putting growth in

an exogenous parameter does little to explain it. Empirically, the stunning range of cross-national experiences makes it clear that the forces driving growth are rich and varied.

One solution to this problem was to move from the CRS production function employed in neoclassical growth theory (it generates diminishing returns to capital accumulation and, as consequence, convergence) to a production function that displays IRS (Romer, 1986). Increasing returns to scale eliminate any kind of convergence and allow for perpetual growth. The problem with IRS is that they are incompatible with perfect competition since marginal costs (or price in perfect competition) lie under the average costs, which means that firms are earning negative profits.

Two assumptions about productivity growth allowed Romer to eliminate these two problem. First, an increase in a firm's capital stock leads to a parallel increase in the stock of knowledge (learning by doing); second, firm's knowledge is a public good that any other firm can access at zero costs. Hence, once discovered, a piece of knowledge spills over instantly across the whole economy (knowledge spillover). These hypotheses allowed for social increasing returns in production, but made private production CRS. This was achieved by making capital investment have social benefits not reaped by private investors. These externalities allowed for the conbination of competitive behavior and IRS that made growth possible in a model.

For this model to be more than a mere technical curiosity, Romer needed to present convincing evidence that (1) there existed a form of investment that generated these massive spillovers; (2) this form of investment was important and becoming increasingly so; and (3) the real world resembled the predictions of his model. The form of investment Romer suggested was the accumulation of knowledge.

The main message of Romer is that the generation of new knowledge was the key to economic progress and that understanding the conditions that allow knowledge to expand quickly was the key to economic growth.

Lucas (1988) linked this generation of new ideas with cities. Two major points of this paper has to be distinguished. First, the biggest change with respect to Romer was that Lucas emphasized human capital investment as opposed to investment in a disembodied stock of knowledge. In a technical sense, the switch is fairly irrelevant; calling the driver of growth "human capital" or "disembodied knowledge" makes little difference to the workings of the model. Conceptually, however, there is a great difference. The argument behind the externalities of human capital are fairly plausible. For example many people have experienced the positive aspects of having smarter colleagues as well as public investment in education is justified in part by the idea that there are benefits to society (such as a better qualified voter) from an educated individual that are not taken into account by that individual.

The second point is his discussion of the role of cities in the trasfer of knowledge. Lucas followed Jacobs (1969) and argued that when one thinks about human capital, knowledge and growth, the role of cities is almost inescapable. Idea moves quickly in cities; unrelated agents come into contact and share ideas. The externalities that this growth literature discusses seem to be much more features of urban enviroments than of agents operating alone in the hinterland.

Lucas (1988) brought to growth economics the idea that cities may be playing a major role in facilitating the accumulation of knowledge spillovers in the growth process.

Barro (1991) is one of the first major empirical papers of the new growth literature. This paper looked at a sample of countries over the period 1960-1985 and investigated why and how they growth.

He simply regressed growth in per capita GDP (once investment and fertility were controlled for) on various national initial characteristics, such as human capital or political variables.
Two facts emerged from this paper. First, the standard form for an empirical literature on cross-country causes of growth. The advantages of this simple format are great, compared with the complexity of the other possible approaches to testing theories about national, regional or urban growth. Growth economists and regional ones, regularly regressed changes on changes, for example GDP growth on industrialized sector growth, or growth in a city on growth in a standard metropolitan statistical area (SMSA). Now, the changes on changes approach is correct only when the researcher is confident of not omitting any relevant variables (contemporaneous changes are more likely to be determined by omitted growth-causing variables than by a change in initial level). Moder empirical style is more likely to focus on the less dangerous (and less ambitious) simple regressions between later changes and earlier conditions than on the testing of a complex multiequation structural model.
Second, Barro's major findings stressed the importance of two forces: education and politics. Human capital variables were particularly important in determining growth. This result has been taken as strong evidence for the importance of skills accumulation in economic progress in the spirit of the knowledge/human capital view of growth emphasized by Romer and Lucas. The political results are also interesting. Barro found that the black market premium, which is an index of the degree of government distortion in the marketplace, is negatively correlated with later growth. Overall the consensus seems to be that national attributes which appear to be bad government, such as instability, dictatorship, corruption and so on, are all negatively correlated with growth, although it is difficult to determine which one matters most (Alesina and Perrotti, 1994).

Krugman (1991) was interested in questions about when and why industry concentrates or disperses. His results have certain basic themes that often interrelate with the urban literature. Krugman constructs a model of production and local IRS (he assumed a fixed cost of production borne by all firms). He then assumed a simple transport cost and looked at th way production situated itself over space. This model predicted multiple equilibria: one equilibrium existed with complete dispersion of activities, and two others with spatial concentration in one region or the other.

Again, two points came to light. First, the model explains why regions develop the way that they do. Frequently one area may have a slight advantage in production, but production becomes concentrated there to an extent that seems far beyond the region's comparative advantage. A multiple equilibria model explains this phenomenon: a slightly advantage might discourage dispersion and through the forces (transportation costs) that lead to spatial concentration, generate extremely high density in one area and low density in others. The force that Krugman used to explain the concentration was that of transportation costs. However the connection between these costs and the concentration is not monotonic. At low levels of costs, lower costs lead to more dispersion both across regions and in the spread to suburbs; at high levels of transport cots, higher costs also lead to more dispersion. The reason is that when trasport is too expensive it becomes more important to be near the nonmobile factor of production.
The paper does not suggest that transport costs were driving most locational decisions, but what we have to learn is that transport costs were one of the forces behind agglomeration. His second contribution is the importance of coordination, expectations and history on regional development. Krugman's work shows the conditions under which history can influence expectation and viceversa.

Roback (1982) is the pioneer paper on cities' literature. It is worth to spend some rows on this work because embodies the underlying idea of the relationship between wage, rents (housing/land prices) and amenities which is the bulk of the following literature. Roback used a general equilibrium model where both the consumer side and the behavior of firms are taken into account (previous studies looked at consumer side only).

The study focuses on two questions. The first one is the role of wages and rents in allocating workers to locations with various quantities of amenities. Cities differ on the level of amenities which are distinguished from the point of view of firms in "unproductive" amenities and in "productive" ones. An example of an unproductive amenity is clean air because firms must spend sources to use a nonpolluting technology. An example of productive amenity is "the lack of severe snow storms" because blizzards may be as costly to the firm in inconvenience and lost production as they are unpleasant to consumers. The idea is the following: if workers require a higher wage to live in a big, dense, polluted or otherwise unpleasant city, the firms in that city must have some productivity advantage to be able to pay the higher wage.

Suppose cities with clean air (unproductive amenity) which are good for consumers but bad for firms. The spatial equilibrium of consumers predicts that:

-given the price of land, nominal wages should be lower in these more amenable cities; i.e. workers are willing to accept lower wages to live in that cities;

-given wages, prices should be higher in more pleasant city to allow people to be indifferent between locations.

The spatial equilibrium of firms predicts that input-factor prices (rents and wage) must be lower in more amenable cities; i.e. firms must pay lower wages and rents because it must spend sources to use a nonpulliting technology.

The result is that wage are lower in more pleasant cities while the sign of prices (rents) is uncertain. The reason is that worker equilibrium requires high rents in pleasant cities to choke off immigration while firm equilibrium requires lower rents in amenable cities to induce firm location.

Suppose now cities with the lack of blizzards (productive amenity) which are good both to firms and consumers.

The spatial equilibrium of consumers predicts that:

-given the price of land, nominal wages should be lower in these more amenable cities; i.e. workers are willing to accept lower wages to live in that cities;

-given wages, prices should be higher in more pleasant city to allow people to be indifferent between locations.

The spatial equilibrium of firms predicts that input-factor prices (rents and wage) must be higher in these more amenable cities; i.e. firms can pay higher wages and rents because it is more productive. The result is that the change in wages would be ambiguous and the rents would rise.

Empirical evidence suggests that in the case of productive amenities (the lack of blizzards, or for example the initial presence of human capital) nominal wages are higher in more pleasant cities (firms' effect prevails). The study also shows that regional wage differences can be explained largely by these local attributes. In cities with good characteristics, the prices of land are higher.

The second question the paper addresses is how to measure correctly the implicit price of cities' characteristics. The implicit price of a city attribute is given by the quantity of land and the quantity of the consumption good workers must forgo because of the lower wage and the change in rents; i.e. it is

measured by the variation of real wage. Given wage, if rents rise then people are evaluating that amenity more and more or in other words consumers are willing to pay more to live in that location with that kind of amenity.
Overall the factor prices are striking a balance between the conflicting locational preferences of of the firms and the workers.

Rauch (1993) is clearly a test of the Romer-Lucas human capital spillover framework and the general equilibrium model theorized by Roback (1982). He starts with the assumption that human capital spillovers are local, that is limited within an SMSA. Given this assumption, human capital externalities can be treated like any other standard urban amenity as in Roback (1982). Rauch uses the Roback's model, so as the latter predicts, wages in SMSA with higher levels of human capital should be higher than those in other SMSAs (Rauch, in a first moment, supposes that human capital increases productivity but has no amenity value. This implies, in the spirit of Roback, that human capital is a productive amenity that rises wages because the behavior of firms overcome that of the consumer. Then he discusses the conseguences of this hypothesis on his results. The conclusion is that the productive effects prevails, as in Roback.). However, so that everyone in the model does not move to the highest human capital SMSA, Rauch needed a balancing force and used the Roback urban restraint on growth, land rents. In highly productive cities, rents should be high to choke off immigration and moreover landowners are expected to charge more for the privilege of living where one can work near smarter people.
Using data with both wages and rents, Rauch was able to test this theory and found that SMSA cities with high levels of human capital had both higher property costs and higher wages, holding individual and dwelling characteristics constant. Even more the magnitude of the spillovers that he found were very close to those found by Lucas (1988) using country data. Rauch's paper presents the strongest evidence to date on the productivity-enhancing advantages of living in cities with higher level of education.
The only remaining problem in the Rauch' s model was one of unobserved heterogeneity. Borjas, Bronars and Trejo (1992) was able to show that given two locations, one with higher rate of return to ability and one with lower rate of return to ability, then the expected value of ability is greater in the location with higher returns to ability. Now if the returns to ability are positively correlated with the average level of aducation in a certain location, then the positive coefficient of education in the wage equation reflects selection bias. In other terms is likely that higher quality workers will migrate to SMSAs with higher average education.
Although Rauch tried to shed light on the evidence favoring the productivity (human capital) interpretation of the wage effect over the selection bias interpretation, his attempt was subject to criticism.

Glaeser (1992) and Glaeser and Marè (2001) attempted to understand whether there is a real productivity difference between dense urban areas and other areas or whether dense urban areas just have higher wages because they have higher ability workers. To solve the problem they looked at migrants to cities with higher average levels of human capital and to cities in general.
These papers begin with the stilyzed fact that there are wage differences across space: wage are higher in big metropolitan areas than outside metropolitan areas. If workers with the same skill are being paid higher nominal wages in cities, then there are two puzzles to explain. First, we must understand why workers do not flock to these higher higher wage. Second, we must understand why firms do not flee

these high-wage areas. The labor-supply question (why do workers not to come to high wage cities?) requires that real wages must be constant over space, i.e. prices are higher in large cities; that is the Roback's idea must hold. The labor demand question implies that, firms to stay in high-wage areas, either workers in those areas must have higher ability levels or productivity must be higher in those areas.

So, the question becomes why density increases urban productivity. There are different explanations:

-firms in dense areas save on transportation costs (Krugman,1991);

-firms acquiring ideas from their neighbors (Lucas, 1998; Rauch, 1993);

Since the productivity of firms in cities will be higher, workers will be paid more. These theories also predict that recent migrants to cities will receive immediate wage gains and that migrants who leave cities will see their wage drop to the level of rural workers.

Another possible explanation of urban productivity is that cities enhance the accumulation of human capital. Urban density can speed the rate of interactions with high-skill individuals who can be imitated or the rate at which agents have new experiences. Cities may also facilitate coordination and allow individuals to specialize, which may lead to higher wages only over time. Urban density may make it easier for workers to find the best jobs for themselves, and urban wages mat grow more quickly because of better coordination of labor markets. In contrast to the previous theories, the latter predict a wage growth effect.

The wage growth and the wage level effect can be distinguished by examining migrants. If the wage growth effect is correct, workers who come to cities may not receive large wage gains and workers who leave cities will not experience wage losses. If so the higher wage premium in the cities is the result of a learning, improving-productivity process. The wage level-theories predict both wage gains and wage losses.

The rrs found that wages did not rise immediately for migrants when they entered new cities, instead there seemed to be a slow increase over time. Furthermore there was evidence of a little loss when they leave the city. However the results were not robust. The conclusion was that the wage difference across space was caused both by a slow accumulation of productivity in cities with high levels of human capital and unobserved eterogeneity; i.e. the urban wage premium appears to be a combination of a wage growth effect and a wage level effect.

3. Growth, human capital and the role of cities: the micro approach.

What we have learned until now is that knowledge was the key to economic progress and that understanding the conditions that allow knowledge to expand quickly is the key to economic growth. Human capital investment is the kind of knowledge that generates massive spillovers. Moreover, ideas move quickly in cities. This section details some of the theories about the ways that dense, urban areas should change the returns to skills.

The microeconomic foundation of the external effects of human capital is the sharing of knowledge and skills between workers that occurs through both formal and informal interactions (Glaeser, 1994). The diffusion and growth of knowledge that takes place as a result of that interaction is modelled in a paper by Jovanovic and Rob (1989). In their model individuals augment their knowledge through pairwaise meetings at which they exchange ideas. In each time period each individual, seeking to augment his knowledge, meets an agent chosen randomly from a distribution of agents/ideas. It

seems clear that the higher the average level of human capital (knowledge) of the agents, the more luck the agents will have with their meetings and the more rapid will be the diffusion and growth of knoledge. If this knowledge concerns technological improvements, we have a microeconomic fundation not only for external effects of human capital on total factor productivity, but also for making those external effects dependent on the average level of human capital.

Given the existence of human capital externalities, economically identcally workers will tend to earn higher wages in human capital rich than in human capital poor countries. The problem with inferring that human capital externalities cause these wage differencial is that a high average level of human capital is associated with a high level of economic development. A high level of economic development is in turn associated with other factors that tend to cause high wages such as a large and technologically current stock of physical capital per capita (from Solow, $dw/dK>0$). For this reason it would be very difficult to econometrically identify the effects of human capital externalities using cross-country data. By looking at different regions within one country, however, one can identify these effects, since the cost of capital and the level of disembodied technological knowledge will presumably be the same within its boarder. Indeed Lucas (1988) argues that cities are the most appropriate units to examine when looking for the productivity-enhancing effects of human capital. It seems reasonable to think that random meetings, as opposed to costly, prearranged ones, would take place within a limited spatial area rather than uniformly distributed over an entire country; i.e spatial proximity allows ideas to flow more freely.

In what follows, we present some theories that highlight why cities spread ideas.

(A) The Transfer of Knowledge. Marshall (1890) suggests that skills are often learned through imitation, and the imitative process is speeded up in cities. By comparison with nonurban workers, workers in cities learn their talents better and by observing errors more often, they can learn to avoid them. While the exposure to throngs of individuals and activities in cities might serve as an immediate jump to worker productivity, it also increases a worker's human capital over time. These arguments, when applied to the learning of skills, suggest that wages in the cities should not be raised immediately but over time, as workers improve their human capital by observing others and gaining access to a wide variety of ideas and production techniques. In general wages should grow more quickly in larger cities, and perhaps more quickly among workers with more formal education, assuming they are the workers most likely to invest greater and cheaper effort in human capital. These kind of spillovers suggest a particular pattern of wage movements; however neither the presence of these movements nor their absence validates the theory of intellectual spillovers or invalidates the connection between intellectual transfers and cities, since there are many other ways in which transfers might operate.

More traditional arguments about transfers and cities suggest that intellectual transfers increase the productivity in cities and might even increase the productivity of better trained workers to a greater extent, but that these effects should not work directly through facilitating human capital investment (Lucas, 1988; Rauch, 1993). These arguments are distinguishable from the former because they predicts a wage-level effect for new migrants (see the selection bias problem).

(B) Coordination of Talent. The literature on matching (Becker and Murphy, 1992; Jovanovic, 1992) emphasize the importance of coordinating workers and jobs. The possibile role of spatial proximity in facilitating good matching has older roots. Marshall (1890) emphasized that industrial concentration mighy be important because it facilitates coordination of talents. Thus, if the structure of cities allowed workers to choose among firms and find the best possible match, an urban wage

premium would be created. Workers would get a higher return on ther human capital by being matched to the right job. Again thies effetct would heighten returns only gradually, as workers were able to access the urban labor market and make a correct match.

(C) Specialization and the Extent of the Martket. A similar argument asserts that cities should allow workers to pursue particularly specialized tasks. Urban ares are especially hospitable to specialized tasks bacause thay have larger markets (Smith, 1975) and because coordination costs for the same number of people may be lower in urban setting (Becker and Murphy, 1992). If cities facilitate specialization, this phenomenon might have several effects on human capital. First, workers might only receive the wage benefits of cities when they have specilized further and it will take time to achieve their gains. Second, specialization might be complementarity to human capital, so that highly skilled workers in particular benefits from being in cities. Finally there is a counter-argument that specilization is actually a substitute for skill, in which case more highly skilled workers will not benefit from being in cities.

(D) Risk, Urban Diversity, and Investment. Another conceivable way in which cities interact with human capital accumulation is that they might reduce the risk to workers in undertaking human capital investment. Following Marshall's argument, according to which industries agglomerate ensures their workers will have another firm to move to, it should be true that workers will be more likely to invest in human capital if they are assured that one company's collapse will not leave their investment valueless. Similarly the argument by Rotemberg and Saloner (1991) the industrial concentration saves the worker from the firm's having axcessive bergaing power also works to increase the incentives for worker investment in human capital. Because workers know that they can play one firm off against another and will not be subject to ex post appropriation, after their human capital investment, they will be more willing to invest in skills. Again this argument suggets that the urban wage premium should show up over time.

(E) Cities and the Provision of Education. Cities have a long tradition of providing public education. Because of political factors, increasing returns to scale in public education, or easier specialization in teaching, cities traditionally have own universities and frequently a great number of secondary schools. Public school education began in cities. It is often argued that migrants to large cities in less developed conutries are drawn by the prospect of better education for their children.

Glaeser, Kallak, Scheinkman and Shielfer (1993) used urban data to test three possible forms of human capital spillovers. First, MAR (Marshall-Arrow-Romer) increasing returns spillover. This view says that the concentration of an industry in a city helps knowledge spillover between firms, and therefore, the growth of that industry and of that city. Through spying, imitation, and rapid interfirm movement of highly skilled labor, ideas are quickly disseminated among neighboring firms. When idea transfers involve the latest new information, the benefits to extremely high density become much larger. For example, success on Wall Street often involves knowing new events minute before anyone else. In this environment, the informational advantages of extreme spatial proximity become very high. The possibility of seeing someone with knowledge while taking a coffee may lead to large financial returns. This difference between the need for lower frequency technological updates and high frequency news may explain why Silicon Valley works well at low density and Wall Street remains in a tiny physical area in the tip of Mahnattan. In both cases, however, the spatial concentration of economic actors increases productivity at the firm level by increasing the flow of ideas. Insofar as workers learn how to better perform their jobs through observation, the existence of learning-by-seeing

will favor the densest of workplace environments. This view of workers suggests that wages are higher in cites not because individual firms are more productive but rather because workers in cities have acquired more (unobservable) skills.[1] The MAR theory also predicts, as Schumpeter (1942) does, that local monopoly is better for growth than local competition, because local monopoly restricts the flow of ideas to others and so allows externalities to be internalized by the innovator.

Second, Porter (1990), like MAR, argues that knowledge spillovers in specialized, geographically concentrated industries stimulate growth. He insists, however, that local competition, as opposed to local monopoly, fosters the pursuit and rapid adoption of innovation. He gives examples of Italian ceramics and gold jewerly industries, in which hundreds of firms are located together and fiercely compete to innovate since the alternative to innovation is collapse. Porter's externalities are maximized in cities with geographically specialized, competitive industries.

Third, Jacobs (1969), unlike MAR and Porter, believes that the most important knowledge transfers come from outside the core industry. As a result, variety and diversity of geographically proximate industries rather than geographical specialization promote innovation and growth. Thus the crucial externality in cities is cross-fertilization of ideas across different lines of work. New York grain and cotton merchants saw the need for national and international financial transactions, and so the financial services industry was born. Another example is the brasserie industry which spur dressmakers' innovation rather than the lingerie industry. Moreover "the diversity of urban activities quite naturally encourages attempts to apply or adopt in one sector (or in one specific problem area) technological solutions adopted in another sector" (Bairoch, 1991; pag. 336). Jacobs also favors local competition because, like Portes, she believes that it speed up the adoption of technology.

These theories are extremely appealing because they try to explain simultaneously how cities form and why they growth. Despite their differences, all these theories have implications for growth rates.

The data used were 30-year employment patterns across SMSAs. The authors used two measures of initial scale as thei basic controls: overall employment and relative employment. These scale measures are supposed to reflect the Romer-style theories about the way pure size increases the ability to generate new ideas. They found both initial measures negatively correlated with later growth and concluded that initial concentration does not seem to foster creativity; i.e. scale economies on the local-industry level do not really create growth.

The second result was that urban diversity is positively related to later growth. Using a concentration index, they found that city-industries in highly diversified cities grow much more quickly than city-industries in one-industry towns. This finding, supports Jacobs' idea that growth is a function of cities combining unrelated activities and that the biggest innovations result from a combination of seemingly unrelated ideas.

The third finding was that more competitive industries grow much more quickly. It can be interpreted as a statement that competition breeds growth, and can also be interpreted as evidence for the dynamic benefits of smaller firms over monopolies.

[1] Urban density can also create a worker productivity premium even if technology isn't changing. The idea is that the large number of employers within an urban area will enable workers to change jobs more easily. This provides an advantage to workers if their firms receives a negative productivity shock (workers in Chicago can always go to another firm in that city, but worker in Hershey, Pennsylvania may lack that luxury. This also makes it easier for younger workers to find the right career for themselves. In a large urban area, they can hop jobs and careers at much less cost than in a low density environment. These ideas do not imply that firms in cities will pay more, but they do imply that workers in cities are more likely to be better matched with their employers.

4. Evidences from the USA.

4. 1 Some stylized facts about the recent growth of (the U.S.) Cities.

Glaeser, Scheinkman, and Shelfier (1995) and Glaeser, Ponzetto and Tobio (2011) found that the following empirical facts have held for the US SMSA and counties across a long period of time. In this section, first of all we list this facts and then discuss how literarature has explained this stylized facts.

(1) Income growth and population growth move together. A fundamental issue when thinking about urban growth is, how does one measure growth? Across countries, increases in per capita GDP seem to be a natural way to measure the economic growth of countries. Across cities, this choice is much less obvious. General equilibrium models a la Roback (1982) show that any real differences in income across cities should be quickly eliminated by migration, and any differences that remain reflect negative amenities, such as higher rents in the higher wage city. Employment or population growth is in fact the more natural way for looking at growth across States or cities with free migration.

Alternative methods of measuring growth might include looking more closely at the housing and real estate markets. Increases in land prices and development of new real estate structure might prove to be an important, alternative index of the degree of expansion of a city. The relative preferability of one index of growth to another depends on the elasticity of supply of new structures. (Perfect elesticity of real estate supply means that growth will show up of new structure, not in prices. Perfect inelasticity of real estate supply means that prices alone will reflect growth).

One of the interestings things about growth across U.S. cities in the period 1960-1990 is that the income and population move together, so that most things that predict per capita income growth predict population growth as well. There are three explanation for this fact. The first is that changes in urban population were labor demand driven. Certain cities experienced positive shocks to demand for their products and as a result both wages and employment rose. This explanation is plausible only if one believes that migration would not have eliminated the wage increases over time.

The second explanation is that growing cities experienced an increase in the number of highly skilled workers. More highly skilled migrants might have been going to the more popular cities.

A third explanation may that the popular cities had some attribute that was valued more over time, such as the initial skills distribution of the city.

(2) Population growth persists. The cities that grew from 1950 to 1970 also grew from 1970 to 1990. In fact the best predictor of whether a city will grow over the next 20 years is whether or not it has grown over the past 20 years. There are several interpretation for this persistence/correlation.

A simple one is that there are good cities and there are bad cities. The good cities just keep growing, and the bad cities keep declining. What makes a city good or bad depends on the specific case, but it seems easy to argue that there are profound city-specific effects that determine growth.

Another interpretation is that growth generates growth despite the congestion problems. Models such as Krugman (1991) suggest that the presence of other people is one of a concentrated area's biggest attactions. If such forces are at work, then one would expect a positive shock to a sector's population in one period to be followed by a second shock in the second period.

A third interpretation is that the postwar period has simply featured remarkable continuity in demand and supply shocks to urban areas. The products that became more valuable from 1950 to 1970 also became more valuable over the later period. The urban attributes that rose most in their evaluation by residents during the earlier period also rose more in value over the later period. The demand story would focus on the postwar rise of services relative to manufacturing. In Table IV the paper, shows that: a) population of cities significantly involved in manufacturing grew much less than that of cities less involved in manufacturing; b) a high initial exposure to manufacturing has an adverse effect on the growth of more manufacturing and non-manufacturing employment in a city and non solo on the growth rate of population; c) manufacturing cities declined not only in terms of population but also in terms of per capita income. These results suggest that cities followed the fortunes of the industries that they were exposed initially. Non-manufacturing activities did not move into cities where manufacturing declined; rather, the population of these cities declined through emigration and incomes fell.

Moreover, these results seem supportive of a vintage capital model, where cities that invested in older types of capital do not replace that capital as it becomes obsolete because a) exsisting capital represents a sunk investment and b) the pre-exisisting capital crowds out newer capital. This crowding may occur because scarce resources (available land) are used with older capital. As capital becomes more out-of-date the marginal product of labor, the wage rate (and eventually population) fall. The labor supply story would focus on the value of certain amenities such as weather rising perpetually over the period (on this point see Glaeser and Tobio, 2007).

(3) Human capital generates growth. This fact is consistent with Barro (1993) finding that schooling precedes the growth of a country's GDP. Interpretations abound. Highly skilled individuals make cities good by generating ideas and productivity-enhancing innovations. These ideas and innovations then attract migrants and raise everyone's wages at least in the short run. As skills became more valuable, the incomes in cities with highly educated workers rise because the workers were being paid more. Also, if the education of a community influences the education of the individual, a nationwide rise in returns to skills would create incentives for individuals to flock to places were there are highly skilled people from whom to learn.

Another interpretation is that these results reflect government or politcal economy concerns. More highly educated people might have created better schools systems through increased spending on schooling and greater parental involvement. Better schools might have attracted more residents to the city. In general, education might have been linked to the quality or government, and governmental quality might be attracting capital and labor to the city. A final possibility is that low-skilled people might elect officials who support redistributional policies that deter capital and high human capital labor flows.

(4) Schooling Follows Schooling. The connections means that cities which began with a high degree if schooling had the greatest increases in percentage of college-educated people. The well-educated moved (or were born) in greater numbers where well-educated people were already located. One explanation may be that migrants tended to be better aducated members of the population, in part because they are younger. Because cities whose inhabitants have a higher average level of skills attracted more migrants, they had more well-educated people than other cities. Another interpretation is that more educated people benefit from being with others of similar aducational level. As time passes, people sort themselves out so that they can be near those whom they like best.

A final explanation is that this sorting occurred not because of complementaries among highly skilled individuals but because of the political economy. If governments have increased their activities as redistributors of incomes, then there is a greater incentive for sorting across cities. When cities redistribute income, it is more important for highly paid individuals to live among similar people who do no want redistrubutional policies.

(5) Schooling Becomes More Important Over Time. The importance and the accuracy with which education can explain population change, has risen over time. If skills have become increasingly valued by firms, it is not surprising that the ability of schooling to generate growth has risen as well. If being around skilled people is like having skills oneself, the nit is much more important to be around skilled people in the later period. The increased connection between schooling and population growth can therefore be explained because migrants have increasingly desidered to be around highly skilled people.

An alternative explanation again emerge sas a political economy story. Between 1950 and 1970, cities were not yet involved in resistributional activities, so there was less of an incentives to flee cities with low levels of human capital. Between 1970 an d 1990 redistribution increased, so for those people who wanted to avoid it, being around people with high levels of human capital became more important.

Summing up we can say that then measure of city growth is the growth of its population. Using employment growth provides qualitatively equivalent results (Glaeser, Scheinkman, and Shelfier, 1995; pag 10). Population growth might not be appropriate for a country because population is relatively immobile and differences in population growth mainly reflect differences in fertility. Income growth is a natural measure of productivity growth across country because of the immobility of labor.

With cities the situation is different: income growth captures some portion of productivity growth given labor, but also captures declines in quality of life (due to negative amenities such as higher rents) Then it is a less perfect measure of general urban success.

The fact that income and population results are in similar direction suggests that either (1) movements in wages and population are generally determined by productivity changes not quality of life changes or (2) the same factors that cause increases in productivity cause decreses in quality of life. The second explanation is less plausible also because requires one to believe that unemployment has made cities a more pleasant place to live.

4.2 Testing the empirical facts.

Between 1860 and 1920 the number of American cities with 10000 or more people increased from 93 in 1860 to 752 in 1920; the number with 100000 or more people increased from 9 to 68. Not all cities, however, participated equally in the trasformation. Some cities experienced unprecendent population growth; other cities were nearly stagnant; and still others shrank.

Simon and Nardinelli (2002) examines the determinants of city growth over the period 1900-1990, in both the cross-sectional and time series regressions. Specifically employment growth regressions for city-aggregates for the period 1900-86 and for metropolitan areas (SMSA) over the period 1940-90 are carried out. What determined which cities rose and which fell?

(A)- American cities with proportionately more individuals with high levels of human capital in 1900 grew more rapidly over the next 86 years (in the long run) because knowledge spillovers are geographically limited to the city (see fact No. 3);

(B)- The effects of human capital is very persistent. This indicates that the distribution of human capital established in the first decade of the 20th played a role in current status of American cities. Moreover this suggests either that adjusting to the steady state is very lenghtly, or that shocks to growth are correlated with the presence of human capital (see fact No. 4);
(C)- Human capital is less important today than in the past, perhaps reflecting the decline in the costs of trasportation and communication. This result is in contrast with the fact No. 5. but in line with Krugman (1991) who emphasizes the role of transportation costs, although he nothing says about human capital;
(D)- The rise of the automobile industry appears to have overwhelmed the importance of human capital in cities dominated by manufacturing early on. That is human capital fails to explain growth in 1900 and 1920 in those cities (see fact No. 2, third interpretation).

Shapiro (2006) uses the Roback's (1982) model to investigate the relationship between human capital and growth. A large body of literature confirms the positive correlation between human capital and local area employment (or population) growth. (Glaeser et al., 1995; Simon and Nardinelli, 2002. See fact No. 3). What are the underlying causes of this relationships? There are three possible explanations. First, omitted variables bias. If highly-educated individuals tend to concentrate in cities with better weather and city growth is affected by the weather, a correlation between human capital and employment growth could arise. Second, productivity growth. If human capital is associated with more rapid productivity growth (which implies rapid nominal income growth) then human capital will be positively correlated with subsequent employment growth. Third, growth in quality of life. Suppose that cities with higher concentrations of human capital experience faster growth in the quality of life then human capital and employment growth will covary positively.
Conclusions:
(A)- IV estimates suggest a causal effect of concentrations of college graduates on local area employment growth;
(B)- Evidence from wages and rents regressions implies that while the majority of the employment growth effect of college graduates operates through changes in productivity (as in Glaeser et al., 1995) roughly one-third of the effect seems to come from more rapid improvement in the quality of life;
(C)- In regards to improvement of quality of life, several direct measures of quality of life (number of restaurants per capita, crimes per capita, High-school dropout rate, air quality) indicate that the effect of college graduates may operate through "consumer city" amenities such as bars and restaurants rather than from politically mediated area attributes such as crime, schools and pollution.

Shapiro's (2006) model allows us to distinghish the channels through which human capital affects growth, namely through productivity or quality of life. However, the model does not explain the connection between human capital and productivity and between human capital and quality of life. Regarding the first channel the model is unable to distinguish between technological externalities (see above literature) and pecuniary externalities (Acemoglu, 1996). As for the second, one must explain why human capital is associated with better quality of life. One theory is that concentrations of skilled residents may encourage the growth of consumer services, such as the restaurants and bars, which then make an area more attractive to potential migrants. The following paper clarifies the connection between human capital and quality of life.

Glaeser, Kolko and Saiz (2001) argue that the role of urban density in facilitating consumption is extremely important. As firms become more mobile (they leave cities for the suburbs), the success of

cities hinges more and more on cities' role as centres of consumption. The paper argues that there are four particularly critical urban amenities:
(A) the presence of a rich variety of services and consumer goods. Restaurants, theaters, and an attractive mix of social partners are hard to transport and are therefore local goods. Cities with more restaurants and live performance theaters per capita have grown more quickly over the period 1980-2000 both in the US and France. Large urban markets increase the welfare of consumers because of goods which appear to have substantial scale economies. For example, baseball teams, opera companies, and comprehensive art museums all need large audience to be successful. For consumers, who want to be able to go to the opera regularly or to go live major league baseball games, living in large cities is a necessity. The advantages from scale economies and specialization are also clear in the restaurant business where large cities will have restaurants that specilize in a wide range of cuisines-scale ecomonies mean that specialized retail can only be supported in places large enough to have a critical mass of customers. Clearly not all consumer goods matter. Bowling alleys and cinemas (which are amenities appealing to less aducated workers) are both negetively associated with later population growth. Video games and Video machines have substituted bowling and cinemas. The important consumer amenities are more difficult to duplicate and cater to higher human capital workers.
(B) easthetics and physical setting. There is little evidence o the role of architectural beauty in better performing cities. The consumption value of some cities may be a product of their possession od a valuable stock of buildings that are considered to be aesthetically pleasant. Paris' attraction as a consumer city comes in part from the adventages of its service sector (restaurants) and its products which rely on scale economies to function (The Louvre) but also from its large stock of buildings which are considered by many to be beautiful. An aesthetic edge can clearly come from stock of buildings, but more generally some people may actually prefer city living itself for aesthetic reasons. Moreover, weather is the single most important determinant of population or housing price growth at the county level in the US. Temperate climite, dryness, and proximity to the coast are strong predictors of local growth.. Physical attributes of a community that make life more pleasant appear to be increasingly valued by consumers;
(C) good public services. Good schools and less crime are also linked with urban growth. Schools and low crime also appear to be important in attracting a highly educated workforce;
(D) speed. In a sense the range of services (and jobs) available in ametropolitan area is a function of the ease with which individuals can move around. As time becomes more valuable, individuals will particularly avoids areas where transport cost are high. Indeed, the movements to edge cities and the decentralization of employment (firms) have increased communting distances but often decreased commuting times relative to treditional downtowns. Perhaps the most obvious facts pointing to the importance of consumer cities is the rise of reverse commuting. Reverse commuters live in central cities and worl in the suburbs. Since they are generally paying higher rents to live further from their place of work, the most natural explanation is the demand for the consumption value of central city. These changes reflect the relative rise in suburban employment, but they also reflect the rise of consumer city.

The paper shows the relantionship between the log of population SMSA and the logs of both wages and housing prices in the US. In 1980 the elasticity of wages with respect to metropolitan population was 0.051. By 1990, the elasticity had risen to 0.082. Thus, if anything, the urban productivity edge appears to be rising. In 1980 the elasticity of housing prices with respect to

metropolitan population was 0.114. While this elesticity is already large, the elasticity has almost doubled by 1990 to 0. 225. It appear that the demand for cities is rising quicker than the urban wage premium. In cities with more educated populations, rents have gone up more quickly than wages since 1970. The natural interpretation of this fact is that while productivity has risen in places with more educated workers, quality of life has risen faster. The future of cities increasingly depends on whether cities are attractive places for consumer to live.

The Rise of the Skilled City by Glaeser and Saiz (2004) is an attemt to answer the following queation: why have people increasly crowded around the most skilled? Why does education seem to be an increasingly important ingredient in agglomeration economies? Three disparate, but not incompatible, visions of the modern city offer different answers to these questions.

(A)-*The Consumer City view* (Glaeser, Kolko and Saiz, 2001) tell us that skills predicts growth because skilled neighbors are an attractive consumption amenity; that is cities are increasingly oriented around consumption amenities, not productivity;

(B)-*The Information City view* (Jacobs, 1969)tell us that we should expect cities to be increasingly oriented around the skilled because the skilled specialize in ideas; that is cities exist to facilitate the flows of ideas;

(C)-*The Reinvention City view* (Glaeser, 2005: Reinventing Boston, 1630-2003) tell us that human capital predicts city growth because human capital enables people to adapt well to change; that is cities survive only by adapting their economies to new technologies.

In this paper, the authors follow the framework in Shapiro (2006). As we saw, the framework tell us that production-led growth should increase nominal wage and housing prices, while comsumption-led growth should cause real wage to fall. Rising nominal wages is a sufficient condition for productivity growth and declining real wages are necessary for the amenity story to be of relevance.

The analysis is based on a sample of 318 metropolitan ares and 723 cities in the year 1970, 1980, 1990 and 2000. Specifically population growth regressions, income growth and rents growth regressions for metropolitan areas (SMSA) and cities are carried out. The paper shows that:

- At the metropolitan area level, evidence shows that skills predict productivity growth and not an increase in amenity levels. Prices seem not to be rasing quickly enough to offeset the increasing in wage; in other terms the high skilled metropolitan areas are not seeing falling real wage [Table 8]. Economics reasoning tell us that this means that high skill levels are associated with decreasing relative levels of quality of life, perhaps because of increasing popolation levels. The fact that skills increase SMSA growth through productivity increases, is compatible with both Information City and Reinvention City views.
- At the city level (within a metropolitan area) there is some evidence that prices of skilled places have risen sharply. Given wages (within a metropolitan area) this suggests that skills increase amenities at city level. This result is in line with Shapiro (2005) who suggests that at the city level roughly one-third of the employment (population) growth seems to come from more rapid improvement in the quality of life.

The next two papers are important first because allow us to understand how to study the development of a specific region within a country (think of the South in Italy or the North), second because help us to complete the story of the American cities' development beyond (although inescapable) the effect of human capital on growth.

In the period 1950-2000, population and incomes heve increased steadily throughout much of the Sunbelt. Glaeser and Tobio (2007) assesses the relative contributions of rising productivity, rising demand for Southern amenities and increases in housing supply to the growth of warm areas, using data on income, housing price and population growth. The authors consider three different proxies for Sunbelt status: January temperature, July temperature and location in aone the states of the old Confederacy.

There are three explanations for the population growth of the South since 1950. First, the region may have become more economically productive. Many economists have offered different explanations for the rise in Southern income levels. Sala-i-Martin (1996) emphasizes the greater accumulation of capital in once-backward places. As late as 1940, the South was certainly still backward. Caselli and Coleman (2001) present a related story focused on the structural transformation out of agriculture into industry. Since the South was much more agricultural in 1940, it transformed more quickly. Another view is that the nothern productivity edge came from access to waterways and a dense railroad network which became increasingly irrelevent as transportation costs plummeted during the 20th century. Second, the region may have become a more attractive place to live. According to this view, Southern cities were relatively unpleasant places to live at the start of the 20th century. High levels of heat made summers oppressive and helped the spread of desease. The South also lagged the North in the provision of clean water. Improvements in public health and technological change, such as the introduction of air conditioning, heve made the South a far more attractive place to live. Southern cities, since they are newer, may also have an advantage at adapting to the automobile (Glaeser, Kolko and Saiz, 2003). Thus the possibility to use cars can be seen as a good amenity). It is also possible that as society got richer, people were willing to sacrifice more to live in more pleasant, sunnier climes. According to this view, the South's growth has been driven by improved consumer amenities, not by productivity. Third, the region might be particulary good at producing new housing. Increases in Southern population reflect neither increases in Southern productivity nor Southern amenities but rather a greater Southern tolerance for new construction. In an extreme version of this view, all of American experienced rising housing demand but the supply of housing was much more elestic in the South. Since housing supply was more flexible, more homes were built and more people came to live in the South. More elastic housing supply could come from a greater availability of landa o a more permissive regulatory enviroment. Southern cities might have more lando because they began with less density or because they have fewer natural barriers, like rivers, that limit development. Alternatively, the difference in permitting behavior could be the result of different regulatory environments. Stringent regulatory environments appear to have played a major role restricting growth in many areas outside the South. One view is that the political regime in the South favored new constructions. Note that a more elastic supply of housing means that a higher demand of housing is accompanied by a higher supply, not by a rise of price.

The paper is based on the Roback framework that uses changes in population, income and housing prices to assess out the potential sources for Southern and Sunbelt growth. As we have seen the model predicts that rising productivity will cause population, nominal income and housing prices to rise. When productivity increases, income will rise faster than housing prices and real incomes will also surge. Rising amenity levels or an increasing willingness to pay for the amenities of a location will cause

population and housing prices to rise, but nominal and real wage incomes will fall.[2] An increase in housing supply will cause population to rise, and both income and housing prices to fall.

Using data on income, housing price and population growth for 135 SMSAs and over the period 1950-2000, the paper shows that before 1980, economic productivity increased significantly in warmer areas and drove the population growth in those places. Since 1980, productivity growth has been more modest, but housing supply growth has been enormous. The authors infer that new construction in warm regions represents a growth in supply, rather than demand, from the fact that prices are generally falling relative to the rest of the country. The relatively slow pace of housing price growth in the SunBelt, relative to the rest of the country and relative to income growth, also implies that the growth of the Sunbelt has litte to do with sun-related amenities. Real incomes appear to have been steadily rising, wich suggest that amenities flows are falling. However the results do not mean that air conditioning or clean water was irrelevant, but they suggest that amenity flows would have been far lower without them. Summing up we can conclude that over the period 1970-2000, faster housing supply growth in the South has been as big a factor as economic productivity in driving the rise of Sunbelt population.

In the 1950s, 1960s and 1970s, almost every Northeastern or Midwestern city more than 500,000 people decreased in population size during each decade. In 1990s, a majority of such cities grew: New York City's population grew by 9%, Chicago's by 4%. Between 1950 and 1990 the share of Americans living in cities with more than 500,000 inhabitants fell from 17% to 12%. In the 1990s, the share of the U.S. population living in these big cities finally increased.

Does this mean that city living is back? Do the production and consumption benefits of density have finally acted to reverse the slide of America's largest cities? Were the 1990s a radical break from the past, during which the demand for density has finally ended the push towards the sprawl and the South?[3] Glaeser and Shapiro (2003) tried to answer these questions.

The paper looks at the popolation growth rates of cities and SMSA in the 1980s and 1990s to see if the the 1990s represents a real break with the past. The general conclusion is that the 1990s were much more a period of continuity than of a change. Although the impact of density is less negative in the 1990s than it was in the 1980s, these growth rates provide no real evidence for a revival of dense cities. In the 1900s, as in previous post-war decades, urban growth was driven by the increasing importance of consumers and their tastes for cars, good weather, and skill base of the local community. In other terms, The empirical evidence suggests that the basic stylized facts about urban growth continue to hold. Car cities grow at the expense of public transportation cities. Dense cities decline.

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[2] Remember that firms use labor and land as production inputs. Ceteris paribus, when land prices rise, the cost of production rises as well, therefore firms can reduce the cost of labor paying lower wages. So rising amenity levels can cause both real wage to fall (as we known) but also nominal wage reductions.

[3] Il perché di queste domande si coglie molto bene se si fa riferimento al paper " The Rise of the SunBelt" by Glaeser and Tobio (2007). La storia delle città Americane che ci raccontano Glaeser e compagni è che dal dopoguerra in poi, mentre le città tradizionali del Northeastern e del Midwestern sono declinate, si è assistito ad una crescita delle città del SunBelt; zona quest'ultima caratterizzata da ampi spazi e da un clima molto caldo. Nel paper "The Rise of the SunBelt" si sotiene che prima degli anni 80 c'è stato un incremento significativo di produttività in questa zona che ne ha favorito la crescita (in termini di popolazione e salari). Dal 1980 in poi la crescita nella produttività è diventata più modesta, ma l'offerta di case e nuove costruzioni (incentivata da ampi spazi e poca regolamentazione) è diventata enorme. Ora siccome le nuove costruzioni sono state guidate più da fattori di offerta che da quelli di domanda [ampi spazi e poca regolamentazione (fattori di offerta); preferenza per un clima caldo e possibilità di utilizzare di più l'automobile (fattori di domanda)] i prezzi delle case si sono ridotti anziché aumentare. Questo ha favorito la crescita del SunBelt.

The weather drives a great deal of urban development: warm, dry places do well. Human capital continues to be important.

So, is city living back? The answer is NO! The authors reach this conclusion by focusing on three urban characteristics and their impact on city growth: (A) density; (B) weather and (C) human capital.

(A) The main hypothesis is to test whether there has been an increased demand for large, dense cities in the 1990s; that is whether the impact of variables associated with such cities (density and public trasportation) has changed between the 1980s and 1990s. If dense, walking cities are becoming more popular, we would expect to see measure of density positively predict growth in the 1990s, at least relative to previous years. Moreover, car use should negatively predict growth in the 1990s relative to previous years. Tables (4) and (5) in the paper show that:

- the impact of density is negatively smaller in the 1990s than in the 1980s. This provide little evidence that density is not as bad for growth as it used to be;
- car use strongly predicts growth. There is no difference between 1980s and 1990s;
- public trasportation negatively predicts growth. There is no difference between 1980s and 1990s.

In total there is some evidence that the nagative effect of density has abated somewhat, but the other two results do not predict a reinassance of dense areas.

(B) The second hypothesis is that the impact of weather has changed. Glaeser, Kolko and Saiz (2001), argued that the correlation between weather and growth is evidence of the growing importance of consumers relative to producers in determing the location of cites. Thus the movement of people to warmer, drier cities suggests an increasing importance of consumer amenities relative to production facilities. The consumer city view would predict that weather variables are becoming more important in the 1990s. On the contrary, the view that city living is back might predict that weather variables are becoming less important in the 1990s. Tables (6) and (7) show that:

- the impact of average January temperature (is an index of temperate climate) is significant but smaller in the 1990s;
- the impact of average July temperature (is an index of warm, hot climate) is bigger in the 1990s w.r.t the 1980s and the connection between July temperature and growth is bigger than the connection between January temperature and growth;
- the effect of rainfall in the 1990s is zero, while in the 1980s rain did significantly and negatively predict growth.

Apart from the rainfall, there is little evidence in favour of the consumer city view also in the 1990s.

(C) The third hypothesis is to test if the importance of city-level human capital is continuing to grow. The positive effect of human capital on city growth is evidence that cities grow if they provide opportunities for interacting with skilled people. Contact with the skilled may facilitate learning or the generation of new ideas. If this is the case, we would expect city-level human capital measure to become more important as well in predicting growth. Note also that Simon and Nardinelli (2002) have shown the positive impact of skilled on growth of cities throughout the 20th century. Tables (8) and (9) show that:

-high school degree positively predicts growth. There is no difference between 1980s and 1990s;

-college degree positively predicts growth. There is no difference between 1980s and 1990s;

-the impact of wage (proxy of human capital) on growth is positive. There is no difference between 1980s and 1990s;

-the poverty rate impact is strongly negative in both the 1980s and the 1990s. There is no difference between the two decades.
Summing up, the skill level city remains among the most reliable predictors of urban growth, but there is no evidence for either a pick-up or a slowdown of cities of this effect in the 1990s.

5. Italian cities: the state of the art.

This section discusses deeply some of the recent papers that focus on local growth in Italy. The first five works look at the long-run development of Italian cities and its determinats.

Malanima (1998, 2005) provide an overview of Italian urbanization between 1000 and 2000, which may help in distinguishing the main phases of Italian economic history. In this millenium, three epochs can be singled out: (A) from 1000 to 1350; (B) from 1350 to 1870; (C) from 1870 to 2000. While the first phase is characterised by slow progress and the third by massive urbanisation, the intermediate phase saw declining urbanisation. A strong connection exists, in these periods, between urbanisation and the productivity of the Italian economic system.

The first thing we learn from these articles is the right size of a settlement to be defined "city", acccording to the period we are referring to. From an economic point of view, cities are stable settlements characterized by a prevalence of individuals involved in a secondary and tertiary occupations (such as manufacturing and trade, religious and military services and government). This was the case in the medieval cities of central and northern Italy, but not in the South, where the majority of the inhabitants of both large and small centres were often peasants. This was especially true of Sicily, where sparse settlement did not exist at all, and the population lived in large urban villages. If we consider these villages as towns, Sicily at the beginning of the nineteenth century would rank as the most urbanised region in Europe, and perhaps in the world, with an urban population of 66 per cent, that is to say, the same urban percentage as Italy in the late twentieth century.
This fact suggests two things. First, it is always advisable to distinguish South and North. Second the author suggests to use centers with over 5,000 inhabitans for the periods 1000-1350 and 1350-1870. For Italy between 1861 and 1971 geographers and demographers propose to use *comuni* with more than 20,000 inhabitants and a predominance of secondary and tertiary activities.

These studies intend to present an overview of Italian urbanization trends between 1000 and 2000 and the causes of these trends in each of the three epochs decribed above.

The first phase: 1000-1350. In all of Europe, from 1000 until1300, there was little if any increase in the urbanisation rate. In Italy, on the contrary, the rate doubled at least. Figures for Italian cities in 1300 suggest that the urban share was over 20 per cent. The urbanisation rate doubled or even trebled in 300 years. Insofar as we can trust Tuscan figures, urban growth was rapid during the thirteenth century, when new walls were built to encircle several expanding cities. In Tuscany, by the end of the century, there were twice or three times as many urban inhabitants as at the start of it, while the population of the Centre and North had increased by 50 per cent. A rise in Tuscan urbanisation from 10-11 per cent in 1200-1300 to 26.3 per cent by the end of the thirteenth century has been suggested.
During the late Middle Ages new centres sprang up or increased in population to become major cities. The best-known example is Venice, but major developing cities, founded after the decline of the

Western Roman Empire, were Amalfi, Ferrara, Alessandria, Udine, Cuneo, Viterbo, L'Aquila, Fabriano, Macerata, Foggia, Molfetta, Lecce and Catanzaro.

At the same time, a slow change was taking place in the balance between the South on the one hand, and Centre-North on the other. Towns in the South and the Islands, already flourishing during the Arab period, continued to develop. The rate of urban growth in the North, and particularly in the Centre, began to outweigh that of the rest of the peninsula and that of Sicily too. Although it is hard to compare the North and the South, we nevertheless know that in 1300 the urbanisation rate was already higher in the Centre- North than in the South and the Islands (21.4 against 18.6 per cent). Three cities (Florence, Venice, and Milan), forming a triangle in northern and central Italy, were the dominant nodes, surrounded by many smaller centres.

The second phase: 1350-1870. In this phase the central and northern Italina urbanisation rate diminished from more than 21 about 16 per cent.

No meaningful change in urban hierarchy occurred in the period from 1300 to 1800, as the rank-size distribution shows. The main changes were the relative growth of a few cities, primarily Turin; and (most importantly) the relative decrease of urbanisation in central Italy. While in 1300 some 40 percent of the urban population of North-Central Italy lived in Umbria, Marche and Tuscany, and the remaining 60 per cent in the North, in 1861 the ratios were, respectively, 21.5 and 78.5 per cent. The balance of urbanisation had shifted towards the North.

It was only in this second phase of its urbanisation that Italy began to lose ground vis à vis North-West European regions. If we consider centres with more than 10000 inhabitants, urbanisation nearly doubled in Western Europe between 1500 and 1800 and a sharp acceleration took place between 1800 and 1850. In Italy, urbanisation declined during these centuries and this decline did not stop with the beginning of the nineteenth century. Before 1900, three regions played a decisive role in the European economy, each gaining dominance in succession: Central-Nothern Italy, the Netherlands and England.

The third phase: 1870-2000. From 1861 to 1961, the population of North-Central Italy doubled, and its urban population multiplied by 6.5. Every decade, from 1880 onwards, more than one million people moved to the cities; this figure rose to 3.2 million between 1951 and 1961, when the migration towards the cities reached its peak; and stayed at 2.3 million between 1961 and 1971. Between 1861 and 1971, 16 million people migrated from the countryside to the most industrialised cities. This flow slowed down from the late 1970s on, and ceased altogether in the1980s, by which time almost 70 per cent of the total population lived in cities.

A long period of demographic growth and urbanisation, which had begun some ten centuries before, was coming to an end.

The next question is: what were the causes of these trends? First of all we need to distinguish between a rural and an urban sector, respectively characterised by the production of food and raw materials, and of secondary goods and services. As regard the first sector, two models linking agrarian productivity to urbanisation in the premodern world have been development. The first was worked out by Wringley (1986), the second by Persson (1991). In Wringley's model, agricultural productivity is related to the ratio of urban to rural population. Persson later generalised the same model by taking into account the urban-rural wage premium and the marginal propensity to consume rural goods. Persson estimated that, given a marginal urban propensity to consume rural goods of 0.5, a ten percent increase in urbanisation, accompanied by a rise in the wage premium, implies a doubling of labor productivity in the countryside. According to both models, increases in urbanisation make heavy

demands on the rural sector. Because of this link between agricultural productivity and urbanisation, the latter can only occur under one of two conditions. Suppose that either agricultural manpower and capital are underemployed. First, given capital, if the underemployment of manpower is reduced, then actual production move towards the production possibility frontier. Second, given labor, if capital formation or technical progress allow for a rise in productivity, again this same curve moves outward. Suppose now that agricultural production has already reached its maximum potential level and there is no possibility for technical progress. In this case the only result can be an increase in the relative prices of food and raw materials in the cities, and an halt to the urbanisation process. This is what happened in many rural economies whose increasing urbanisation was not supported by agricultural productivity rises.

Clearly in both models, it is possible to include the relationship of the economy with external markets, in cases when exports and imports are significant. After all, when agricultural inputs for urban expansion are lacking in neighbouring regions, it is always possible to import materials. In premodern era an advantage was that Italian towns could be provisioned in food and raw materials by sea, and at lower cost. For several centuries, northern Italian cities consumed cereals imported from southern Italy and raw materials from all over the Mediterranean. Another advantage was the Italian cities' relatively modest per capita consumption of firewood. Thanks to their climate, they needed no more than 1.5 kg per person per day, against the 5 kg of central and nothern European cities.

A low labour productivity in the rural area surrounding a town could be a constraint on urban expansion. A major change has come about recently with the rise of trade in agricultural goods on a global scale. Today, since cities no longer depend solely on the produce of their rural surroundings, urbanisation can coexist with low agricultural productivity growth. For this reason it is important today to look at the secondary and the tertiary sectors. Since a differential in labour income is what leads to migration towards the cities, the rise in productivity must be stronger in the cities than in the countryside. The higher the differential, the higher the immigration. In modern era, the urban–rural differential in wage levels still continues to attract population towards the cities, although the actual wages often turn out to be lower than expected, and the hoped-for jobs exist only in certain informal economic sectors. To sum up, we could say that urbanisation requires faster productivity growth in the cities, as the Rosen-Roback framework requires as well.

Malanima (1998, 2005) shows that the three phases of Italian urbanisation outlined above reflect quite accurately the movement of labour productivity, which rose from the tenth to the fourteenth centuries, and even more between 1870 and 1980, but diminished in the intermediate phase, both in the urban and in the rural sector. Following we focus on the third phase.

A rapid shift in the production possibility curve took place in Italy only at the end of the nineteenth century, with the so-called Second Industrial Revolution. Population increased rapidly, at a time when productivity was rising. Wage differentials were also increasing in favour of the cities, encouraging migration from rural to urban areas. Structural change was taking place. In 1861 the secondary and tertiary sectors accounted for less than 45 per cent of GDP. Their share had risen to about 55 per cent by 1911, and was more than 70 per cent just before the World War II.

At the same time, agricultural productivity also increased, but less than industrial productivity. In1861, output per worker was the same in the primary and secondary sectors, amounting to 552-1911 Italian lire in industry as against 526 lire in agriculture. In1936, while agricultural productivity had not yet doubled compared to 1861, industrial productivity had trebled. In1971, productivity levels amounted,

respectively, to 10 and 14 times the levels of 1861. Migration was now possible from agriculture towards employment in industry and services. Differentials in productivity, which also imply differentials in incomes, were pushing people from the countryside towards the centres of industry and trade. Urban attraction intensified after World War II, especially during the so-called 'Italian Industrial Miracle', from the end of the 1950s to the beginning of the1960s. Between 1951 and 1964, while agricultural wages (which were already 60 per cent lower than industrial ones) rose from 100 to 167, industrial wages rose from 100 to 223; (1951=100). Between 1861 to 1961, while agricultural wages rose from 100 to 439, industrial wages rose from 100 to 658 (Malanima, 2005 pag. 117; Fenoaltea, 2001).

Bosker, Brakman, Garretsen, de Jong, and Schramm (2008) studies the evolution of Italian cities over the period 1300-1861, using the dataset assembled by Malanima (1998, 2005). Unit of analysis are cities with at least 10,000 inhabitants. Panel data analysis (RE-GLS) is the choice to analyze the development of Italy's cities. The dependent variable is the log of population (city size). The explanatory variables are: Market access (capatured by urban potential; see pag. 13); physical geography dummies*:* location in a mountainous area (more than 800 above sea level), location along a navigable waterway, location along a major Roman road; roman road crossing in the city (hub city); political/institutional dummies: location in the South or in the North, Capital city of an Italian state; Dummy variables for present-day provinces are also included to control for unobserved city-specific variable (i.e. weather, soil quality, provinces specific institution).

Why do cities differ and how do they develop over time? The general conclusion of the paper is that the main determinants of Italy's city growth are physical geography and political predominance. Specifically the authors emphasize the following results:

(A)- physical geography matters. Transport over water is an important factor determining Italy's city growth. Being a city with a seaport gave a city a big advantage as the bulk of international trade took (and takes) place between the main seaports. Navigable river systems provided cities located on these rivers with a cheap means of trasportation, opening up larger hinterland to these cities that allowed them to engage in international finanze and commerce and to diversify their industries as in Jacobs' (1969) theory.

(B)- political variables matter. Being a capital city has a positive effect on city size. Being a capital city atttracts people as public expenditure is likely to be biased towards the capital city hereby creating jobs and bussiness opportunities alike. The capital city acts as so-called 'parasite' city attracting both capital (in the form of taxes) and people. The impact of the capital city variable on city size is much stronger for Southern cities;

(C)- Urban foreign potential (a city access to other cities' markets) is not significant.

Percoco (2013) differs from Bosker et al. (2007) in its specification of the institutional variables. Percoco (2010) relies on Putnam's (1993) hypothesis: the level of social capital in Italian regions was higher if the main cities in the region had a communal past. Percoco codes institutions in terms of experience of being a free city state in the Early Middle Ages and the presence of a university as a sign of proto-liberalism in governance of the city. He also controls for the quality of regional institutions.

Unit of analysis are cities with at least 10,000 inhabitants from Malanima (1998; 2005) dataset. Panel data analysis (RE-GLS and FE) is the choice to analyze the development of Italy's cities. The dependent variable is the log of population (city size) and centennial population growth.

The general conclusion of the paper is that geography and institutions were crucial in shaping urban development in Italy and in the making of modern cities. In particular the accessibility and the presence of a seaport are important determinants of city growth. The presence of a university has been found to be a key factor in the making of moder cities although this variable should be not considered to measure the presence of human capital, but rather that of a liberal institution.
The explanatory variable, the author use are: (1) geographical variables. Transport costs are the key determinant of city size. Percoco (2010) proxied transport costs with altitude (more than 500 above sea level), road and waterway accessibility (1 if the city was on the Roman road network and 0 otherwise; 1 if the city was on a navigable river and 0 otherwise), and the presence of a port in the city. Market potential is one of the determinants of trade flows. (2) institutional variables. Institutional quality at regional level (see appendix 2) is measured as: Comune (1 if the city was a Repubblica Comunale and 0 otherwise); University (1 if the city had a university in century t and 0 otherwise). As we noted above, medieval universities should be considered liberal institutons because teaching was relatively free, as well as the internal organizations of both students and professors cultural activities. As a consequence the presence of a university in pre-modern cities should be considered, not as a proxy for human capital, but rather as an institution improving urban governance.

Albanese and de Blasio (2014) gauge the role of informal norms (civicness) in Italy's development process during the second half of the 20th century (from 1950 to 2000). By using a dataset at the municipality level and the voter turnout, as a proxy of the "civicness", the authors argue that, during the period analyzed, there was a causal relationship between voter turnout and Italy's economic performance going from the former to the latter. The link with civicness is indirect: voter turnout increases social capital and through this channel economic performance.
Unit of analysis are cities with at least 5,000 inhabitants in 1951; that is about 2,000 municipalities for 6 consecutive Census dates. The authors use three estimators: pooled LS, the between group (BE) and the fixed effect (FE) estimators. The dependent variables they use are measures of economic development are employment rate (employment over population), employment density (employment over squared kms) and plant density (plants over squared kms). The most important explanatory variable, other than geographical variables, is the voter turnout, as a proxy of the "civicness".

The conclusions of the paper can be easily summarized. First, over a half a century, voter turnout has been steadily correlated with measures os economic development. Second, the correlation is likely to reflect some causality going from civic capital to economic performance. Third, the role of civical capital was stronger in the period after the WWII, and decreased gradually in the following decades.

The identification problem, due to mainly to reverse causality, is solved by using past voter turnout as instrument. They take the 1913 voter turnout, that is participation at the polls of the first election with universal manhood suffrage in Italy. This strategy makes sense if (i) there is some persistence in the spatial distribution of the variable of interest; (ii) the local drivers of economic performance totally differ from those of a long-gone past. As for persistency, the instrument relies on Putnam's (1993) conjecture according to which the endowments of civic capital across Italian territories have been highly persistent over the centuries. In particular, it was the local political regimes in place in the Middle Ages that shaped the degree of local civic commitment that persisted through more than 600 years. As matter of fact, the instrument– voter turnout in 1913 - is suggested by Putnam (1993) himself as one of the possible good quantitative measure of past civic capital. Empirically, the authors

show that voter turnout in 1913 is a significant determinant of the observed voter turnout over the second half of the 1900 (this relationship represents the first stage in the IV approach). With regard to requirement (ii), which technically is referred as the condition of orthogonality of the instrument to the (second stage) error term, and that is basically non testable in the exactly identified case a few aspects have to be noted. First, long-lagged values of civic capital clearly remove any simultaneity bias caused by local shocks that occurred in the second half of the XX century. For such simultaneity to remain we would need these shocks to be expected in 1913 (and have affected voter turnout at the time). However, the Italian economy at the beginning of 1900 was very different from that it was in the second half of the century. This seems to be safe, as major events – such as the two world wars and twenty years of dictatorship under Mussolini – contributed to change abruptly the structure of Italy's economy and society (Zamagni, 1993). Second, the condition might be violated if some missing permanent city characteristic drives both past civicness and XX century economic performance. However, as the authors emphasize, they directly control in the regressions for the most relevant geographic characteristics. Moreover, they also control for population size, which differentiate away potential source of violation of (ii) related to agglomeration.

Dalmazzo and de Blasio (2007) is one of the most representative paper for the Italian case that deal with human capital externalities at the local level. The authors use a general equilibrium model based on Roback (1982) where both wages and rents are simultaneously determined. Their study focuses on the effect of local human capital on household-level rents and individual- level wages for a sample of Italian local labour markets. By collecting data from the Bank of Italy's survey on household income and wealth (SHIW) and censuses data, their results show a positive and robust effect of human capital on rents. This unambiguously demonstrates that the concentration of human capital at the local level generates positive externalities. Specifically, wage equation estimates suggest that the impact of productivity externalities is similar to the impact of consumption externalities. This finding implies that human capital generates relevant externalities on firms' productivity. The main message of the paper is that human capital spillovers matter.

Yet, it is worth to consider two other papers which are quite similar each other. Di Addario and Patacchini (2008) analyze the impact of urban agglomeration on Italian wages. Using a unique dataset of more than 22,000 employees distributed in 242 randomly drawn local labor markets from the SHIW for the four available years between 1995 and 2002, they find that in Italy earnings rise by just 0.1 percent for every 100,000-inhabitant increase in the local labor market. The paper shows also that this effect decays very rapidly with distance, losing significance beyond 12 kilometers. Dalmazzo and de Blasio (2011) examine the impact of agglomeration on both production (wages) and consumption. The paper show that urban agglomeration is a source of positive amenities for residents. In particular, agglomeration has a stronger impact on rents rather than wages. Their empirical findings are consistent with the view that the more educated value urban amenities more than the less educated. Indeed, highly-educated people are willing to pay high rents and accept relatively larger wage discounts to live in cities. Again they exploit the Bank of Italy's survey of household income and wealth dataset.

Spatial externalities and local economic growth in Italy have been studied by Paci and Usai (2001) and Deidda et al. (2002). Paci and Usai (2001) identify the factors that determine technology in the local industry and consequently influences local economic growth. The underlying hypothesis is that technology is not completely exogenous and freely available in the whole economy but it is spatially bounded (Jaffe et al., 1993; Lawson and Lorenz, 1999). Using the average annual growth rate

of employment for each 97 3-digit manufacturing industries in 784 LLMs over the period from 1991 to 1996 as proxy of local growth, thier results can be easily summarized. First, specialisation externalities have a negative influence on labour dynamics at the local industry level, especially for the Southern regions. In contrast they find a positive role of the diversity externalities. The presence in a certain location of a production system characterised by a wide range of other firms operating in different sectors produces positive effects on labour dynamics since it favours inter-industries cross fertilisation. Second, a negative impact on labour dynamics is found for low education and crime rate, while a positive one is detected for university education, cooperation propensity, infrastructures. Third, spatial dynamic analysis shows that at the local industrial level there are polarisation phenomena at work and that positive externalities are self-contained within the boundaries of local labour systems. Similar results are achieved also when the service sector in included in the analysis (Deidda el at., 2002).

Following suggestions from the literature on agglomeration and on social returns to education, Croce and Ghignoni (2012) verify whether training provided by the employers is affected by local knowledge spillovers in Italian LLMs. Their results show that the stock of local human capital, as measured by different schooling variables, has a positive and significant impact on the probability of receiving training from the employer. Moreover, by allowing interactions of local human capital with individual education, it is found that human capital in the area increases the probability of training of workers with an upper secondary degree, while it does not affect those with a tertiary education

6. Conclusion

A science of cities has taken a long time coming but there is now considerable momentum in developing formal ideas about how cities are ordered and structured which are part of the rapidly expanding sciences of complexity. Life in city is exiciting, less grueling, better paid, mobile. City makes us free, people enjoy the vibrant urban life and they are constantly upgrading, but education is the main event that can happen in cities. The strong association between human capital and city growth has been noted for some time (Glaeser et al., 1995; Simon and Nardinelli, 2002; Glaeser and Saiz, 2004; Shapiro, 2006; Dalmazzo and de Blasio, 2007; Glaeser at al., 2011; Duranton and Puga, 2013). In contrast, empirical and theoretical literature concerning the essential topic of what drivers city growth is surprisingly scarce in Italy. We applaude the pioneering efforts that a small group of scholar has already made in this regard (Malanima, 2005; Bosker et al., 2008; Percoco, 2013; Albanese and de Blasio, 2014). We hope our review on human capital, growth and the role of cities in spurring knowledge will stimulate readers as much as it has stimulated us.

Modern urban environments are the driving force of progress and civilization. Today, more than half of the world's population live in cities. In the developed world, it is about 78 percent. More than three out of four people live in cities today. So, cities are where the action is, cities are us. Identifying the factors conditioning growth in cities and examine the existence and the magnitude of spatial spillover generated by human capital, can help us to better understanding the working of local economies and propose public policies for city planners as well.

References

Acemoglu, Daron. 1996. A microfoundation for social increasing returns in human capital accumulation. *Quarterly Journal of Economics*, 111(3):779-804

Albanese, Giuseppe and Guido de Blasio. 2014. Civic Capital and Development in Italy, 1951-2001. *Bank of Italy Economic History Working Papers* 32, Bank of Italy, Rome.

Alesina, Alberto, and Roberto Perotti. 1994. The political economy of growth: a critical survey of the recent literature. *The World Bank Economic Review* 8 (3): 351-371.

Bairoch, Paul. 1991.*Cities and economic development: from the dawn of history to the present*. University of Chicago Press.

Barro, Robert. 1991. Economic Growth in a Cross-Section of Countries. *Quarterly Journal of Economics* 106: 407-444.

Barro, Robert J and Xavier, Sala-i Martin. 2004. *Economic Growth*. MIT Press.

Becker, Gary S., and Kevin M. Murphy. 1992. The division of labor, coordination costs, and knowledge. *Quarterly Journal of Economics* 107:1137-1160.

Borjas, George J., Stephen G. Bronars, and Stephen J. Trejo. 1992. Self-selection and internal migration in the United States. *Journal of Urban Economics* 32(2): 159-185.

Bosker, E. Marteen, Steven Brakman, Harry Garretsen, Herman de Jong and Marc Schramm. 2008. The Development of Italian Cities 1300-1861. *European Review of Economic History* 12: 97-131.

Caselli, Francesco, and Wilbur John Coleman II. 2001. The US structural transformation and regional convergence: A reinterpretation. *Journal of Political Economy* 109(3): 584-616.

Cass, David. 1965. Optimum growth in an aggregative model of capital accumulation. *The Review of economic studies*. 32: 233-240.

Croce, Giuseppe, and Emanuela Ghignoni. 2012. Employer-provided training and knowledge spillovers: evidence from Italian local labour markets. *Regional Studies* 46.3 (2012): 339-353.

Dalmazzo, Alberto and Guido de Blasio. 2007. Production and consumption externalities of human capital: An empirical study for Italy. Journal of Population Economics 20: 359-382.

Dalmazzo, Alberto and Guido de Blasio. 2011. Amenities and skill-biased agglomeration effects: Some results on Italian cities. *Papers in Regional Science* 90: 503-527.

Deidda, Sonia, Raffaele Paci, and Stefano Usai. 2002. Externalities and Local Economic Growth in Manufacturing Industries. Centro Ricerche Economiche Nord Sud, Universita degli Studi di Cagliari, Contributi di Ricerca 02/06.

Di Addario, Sabrina and Eleonora Patacchini. 2008. Wages and the city. *Labour Economics* 15(5): 1040-1061.

Glaeser, Edward L. 1994. Cities, information, and economic growth. *Cityscape* 1(1): 9-47.

Glaeser, Edward L. 2005. Reinventing Boston: 1630–2003. *Journal of Economic Geography* 5(2): 119-153.

Glaeser, Edward L. and Albert Saiz. 2004. The rise of the skilled city. *Brookings-Wharton Papers on Urban Affairs*, 5: 47-95.

Glaeser, Edward.L. and D.C. Mare. 2001. Cities and Skills. *Journal of Labor Economics* 19(2): 316-342

Glaeser, Edward L., Giacomo A. M. Ponzetto, and Kristina Tobio. 2011. Cities, skills, and regional change. HIER Discussion Papers 2191, Harvard Institute of Economic Reseach, Harvard University, Cambridge, Mass.

Glaeser, Edward L., Josè A. Scheinkman, and Andei Shlefer. 1992. Growth in Cities. *Journal of Political Economy*. 100:1126-1152

Glaeser, Edward L., Josè A. Scheinkman, and Andrei Shleifer. 1995. Economic-growth in a cross-section of cities. *Journal of Monetary Economics* 36(1): 117-143.

Glaeser, Edward L., and Kristina Tobio. 2007. *The rise of the sunbelt*. No. w13071. National Bureau of Economic Research, 2007.

Glaeser, Edward L., Jed Kolko, and Albert Saiz. 2001. Consumer City. *Journal of Economic Geography* 1(1): 27-50.

Glaeser, Edward L., and Jesse M. Shapiro. 2003. Urban Growth in the 1990s: Is City Living Back? *Journal of Regional Science* 43(1) 139-165.

Jacobs, Jane. 1969. *The Economy of Cities*. New York: Random House.

Jaffe, Adam. B, Manuel Trajtenberg, and R. Henderson. 1993. Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. *Quarterly Journal of Economics* 108: 577-598.

Jovanovic, Boyan, and Rafael Rob. 1989. The growth and diffusion of knowledge. *The Review of Economic Studies* 56 (4): 569-582.

Koopmans, Tjalling C. 1965. *On the Concept of Optimal Economic Growth*. Amsterdam: North Hollad

Krugman, Paul. 1991. *Geography and Trade*. Cambridge: MIT press.

Lawson, Clive, and Edward Lorenz. 1999. Collective learning, tacit knowledge and regional innovative capacity. *Regional studies* 33 (4): 305-317.

Lucas, Robert. 1988. On the mechanisms of development planning. *Journal of Monetary Economics* 22 (1):3-42.

Malanima, Paolo. 1998. Italian Cities 1300-1861. A quantitative approach. *Rivista di Storia Economica* 14(2): 91-126.

Malanima, Paolo. 2005. Urbanization and the Italian Economy during the last Millenium. *European Review of Economic History*, 9: 97-122.

Marshall, Alfred. 1890. *Principles of Economics*. London: Macmillan.

Paci, Raffaele and Stefano Usai. 2001. Externalities and Local Economic Growth in Manufacturing Industries. Centro Ricerche Economiche Nord Sud, Universita degli Studi di Cagliari, Contributi di Ricerca 01/13.

Percoco, Marco. 2013. Geography, institutions and urban development: Italian cities, 1300–1861. *The Annals of Regional Science* 50(1): 135-152.

Porter, M. 1990. *The competitive advantage of nations*. New York: Free Press.

Rauch, James E. 1993. Productivity gains from geographic concentration of human capital: evidence from the cities. *Journal of urban economics* 34 (3): 380-400.

Roback, Jennifer. 1982. Wages, rents, and the quality of life. *The Journal of Political Economy*. 90:1257-1278.

Romer, Paul M. 1986. Increasing returns and long-run growth. *The journal of political economy*. 94:1002-1037.

Rotemberg, Julio J., and Garth Saloner. 2000. Competition and human capital accumulation: a theory of interregional specialization and trade. *Regional Science and Urban Economics* 30(4): 373-404.

Sala-i-Martin, Xavier 1996. Regional cohesion: evidence and theories of regional growth and convergence. *European Economic Review* 40(6): 1325-1352

Shapiro, Jesse M. 2006. Smart cities: Quality of life, productivity, and the growth effects of human capital. *review of Economics and Statistics* 88: 324-335.

Simon, Curtis J., and Clark Nardinelli. 2002. Human capital and the rise of American cities: 1900-1990. *Regional Science and Urban Economics* 32(1): 59-96.

Smith, M. Estellie. 1975. A tale of two cities: the reality of historical differences. *Urban Anthropology* 1: 61-72.

Solow, Robert M. 1956. A contribution to the theory of economic growth. *The quarterly journal of economics* 70: 65-94.

Zamagni, Vera. 1993. *The economic history of Italy 1860-1990*. Oxford University Press.

Growth in Italian Cities

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This version: September 2014

Abstract

From 1971 to 2001, more skilled cities grew more quickly than less skilled cities. A 10 percent increase in the initial share of college-educated residents is associated with an increase in the subsequent employment growth rate of roughly 0.8 percent. This result holds both at the local labour market (LLM) level and at city level. Most of the connection employment growth-human capital is due to productivity related effects at LLM level; in contrast consumption externalities play an important role in cities. In the latter case, quality of life growth explains from 31 to 43 percent of the association education-employment growth. By using the Bank of Italy's survey on household income and wealth (SHIW) dataset and censuses data, we also find that human capital helps cities to better adapting to negative economic shocks and to restructure their economies as in the case of the North-West. Finally, we try to explain why, in our sample, education predicts employment growth but population decline at the city level. By introducing individuals' heterogeneity, we test the hypothesis according to which a process of "gentrification" may have occurred in Italy. Our findings give us a prelimary evidence of this phenomenon, but additional work is required.

JEL Classification: R11, J24, N930, N940
Keywords: Cities, Regional Development, Human capital, Urban History, Italy,

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1. Introduction[1]

People tend to crowd together in urban areas. Between 1920 and 2010, the population of the U.S. metropolitan areas grew on average by 17.9% per decade overcoming the aggregate growth rate by 5.3 percentage points. In the same time span, in Spain, the urban areas grew by 18.1% per decade exceeding the aggregate growth rate by 9.2 percentage points. In France, cities grew by 7.7% per decade from 1937 to 2007; 2 percentage points higher than the national mean. From this point of view, Italy is not an exceptional country. Italian cities grew on average by 8.7% per decade between 1921 and 2001. This figure of 8.7% exceeds aggregate population growth by 3.5%.[2] In 1971, more than 25% of Italian population was concentrated in the thirty largest cities, which occupied the two percent of the national territory.

During the period 1921-2001, the standard deviation of the population growth rate of Italian cities was 11.5%, that is larger than the corresponding mean. If we look at larger cities (those with more than 50,000 inhabitants in 2001), mean and standard deviation are of the same magnitude, respectively 12.1% and 11.8%. From 1951 to 2001, the ten-year growth rate of employment of 442 Italian cities was on average 39% with a standard deviation of 25% (40% and 22% for the largest ones). These figures suggest that although cities grow over time, they do not grow uniformly at the same rate. Specifically some cities grow and some decline and some cities grow faster than others.

Why do cities grow in population and employment? Which cities grow faster and why? Are there universal laws of urban population growth that hold over centuries, or do time-specific shifts in tastes and technology drive the dynamics of population and employment over space? Inspired by the works by Shapiro (2006), Glaeser and Saiz (2004), Glaeser et *al.* (2011) and Dalmazzo and de Blasio (2011), this paper represents a first attempt to answer all these questions for the Italian case. After all, cities are much more than human habitats; they are crucial and advanced components of the national and global economy, acting as engines of economic development and agents for social change. The role and weight of cities in shaping the Italian fortune has been the object of debates and discussions for a long time. So, it would be a gross mistake to neglect the causes of the size of cities considering that it is a primary aspect of the picture when national economy, politics, society and culture are examined. For these reasons, it is natural to ask why cities exist and how cities change people's lives.

The paper is structured as follows. In section 2, we present some stylized facts about our sample of cities. The primary purpose of this paragraph is descriptive: to understand the dynamics of population and employment over a long time horizon and across space, since both these variable are used by urban economists as measures of city size.[3] In addition, our focus is also on human capital and manufacturing which are extremely important determinants of city growth. The secondary aim is to use the key facts as a guideline for the subsequent analysis. For example, the fact that Gibrat's law is broken over the period 1971-2001 suggests that after 1971 population converged across cities and less

[1] We are grateful to Maurizio Franzini, Michele Raitano, Giuseppe Croce, Francesco Nucci, Massimiliano Tancioni, Marina Capparucci, Paolo Naticchioni, Enrico Marchetti, Sara Pinoli and the members of the Interuniversity Research Center on the Welfare State (CRISS) for comments and support.

[2] Data for the U.S., France and Spain are from Duranton and Puga (2013). Data for Italy come from our computations on census data. Italian cities we focus on, are 442 and they are those listed in the Survey of Household Income and Wealth (SHIW) conducted by the Bank of Italy. For confidentiality reasons city codes are made available only to the staff of the Bank of Italy.

[3] Our starting point is the first year for which data are available: Unification for population and 1911 for employment. The first Industrial Census was carried out in 1911.

populous urban areas grew more quicky. Then it is possible that urban changes reflect individual responses to changing preferences and technologies rather than follow empirical regularities that hold over centuries. Yet, the fact that the Industrial Triangle declined after 1971 may indicate that globalization has facilitated the relocation of many manufacturing plants elsewhere and technological progress had reduced the importance of logistical advantage conferred by this area and, in general, the prominence of the North-West in towing Italian economy. Such initial evidences motivate our more detailed analysis of city growth.

In section 3 we use a spatial equilibrium model to explain city growth. Specifically, we exploit the methodology in Shapiro (2006) and in Glaeser and Saiz (2004) to understand why human capital correlates with employment growth. The hypothesis is that skilled people generate growth because of their ability to innovate and create new technologies and ideas. An alternative, productivity-based, explanation is that human capital spillovers have increased in importance over time. Since both of these theories predict that education-growth connection arises from the increase in the productivity shifter in the production function, they are empirically indistinguishable. Moreover, it is also possible skilled people generate growth in endogenous amenity, such as shopping possibilities and cultural consumption opportunities, and through this channel have a positive impact on employment growth.[4] To distinguish between these two mechanisms, we need to interpret heterogeneity in (housing) prices growth and income growth across cities. The idea is that prices and wages adjust to make agents indifferent across locations. If so, production-led growth requires nominal wages and housing prices to raise, while consumption-led growth requires real wages to fall.[5] Surprisingly, and to our knowledge, this popular methodology has never been applied to Italian data, so the lack of studies on the impact of human capital on urban growth represents one more appealing reason to investigate along this line of research.

Section 4 presents our empirical results. We divide this section in two subsections: in the first one we focus on the relationship between human capital and employment growth in the period 1971-2001 and test its robustness. Once assured that a link between skills and growth exists, in the second part we measure the extent to which the connection between skills and growth strems from productivity or consumption effects. Our attention is on both local labour markets (LLMs) and cities. LLMs are self-contained labour markets, since by definition they are characterized by a very high overlap between the residing and the working population. As a consequence, labor mobility between LLMs is very low as required by the spatial equilibrium concept. Cities within them are smaller and a better unit of analysis for understanding either amenities or real estate prices. Assembling a unique dataset from the Bank of Italy's *Survey of Household Income and Wealth* (SHIW) and from census data, we find the following results. First, from 1971 to 2001, a 10 percent increase in the initial share of college-educated residents is associated with an increase in the subsequent employment growth rate of roughly 0.8 percent. This result holds both at LLM level and at city level. Second, given our calibration of the model, our findings suggest that at LLM level, the connection between human capital and growth is due mostly to the productivity effect. In contrast, at the city level, consumption-related effects seem to play a more important role in driving growth.

Section 5 focuses on the North-West case. Our estimates highlight that in the period 1971-2001, this region performed worse than the other macro-areas in terms of population and employment growth. What are the causes behind this (relative) decline? We believe that the answer should be sought

[4] Glaeser et *al.* (2001) argue that as firms become more mobile, the success of cities hinges more and more on cities' role as centres of consumption. From this point of view, Dalmazzo and de Blasio (2011) is a good example for the Italian case.
[5] See section 3 for a detailed explanation on how the model works and how interpreting its predictions.

in the theory of Jacobs (1969) according to which cities need to costantly reinvent themselves. After the golden years of the 'economic miracle' in the aftermath of the WWII, when low-skilled labour intensive manufacturing represented the lion's share of the local economy, the North-West experienced a spell of crisis and restructuring. A necessary condition for the reinvention story to be of relevance is that human capital should only matter among those cities that have hit by adverse shocks (Glaeser and Saiz, 2004). To test this assumption we use a cross-check strategy.

First, we look at the cross effect between education and manufacturing. Many authors have argued that manufacturing's impact on growth is positive in earlier periods but not necessarily over the long run, particularly in the last decades of XX century. Accordingly Glaeser et al. (1995) suggest that cities followed the fortunes of the industries they are involved. The typical industry's growth follows an S-shaped pattern: rapid growth, followed by slower growth and then decline. If so, we expect that cities with high levels of education and significant manufacturing in earlier periods switched from manufacturing to other industries faster than high-manufacturing areas with less human capital. In other terms, this means that education matters in potentially declining places and helps them to adapt to new circumstances. We find that in the period 1951-2001, the growth in the share of workers in manufacturing declined in those areas that began with high levels of education and significant manufacturing. The Industrial Triangle and, more generally, the North-West were undoubtedly areas with these characteristics.

The other side of the coin is to look at those areas that have experienced positive shocks. Interregional migration has been one of the most important source of employment (population) growth in the last decades of XX century in areas such as the North-East, the Center and the South. By using data from the *Popolazione e Movimento Anagrafico dei Comuni* published by the ISTAT, our findings suggest that human capital does not matter much in immigrant cities, which in turn validate the reinvention assumption.

Section 6 is devoted to the puzzle highlighted by the empirical fact #7: education predicts employment growth but population decline in our sample of cities in the period 1971-2001. We postulate that highly-educated people have stronger preferences for urban amenities than less-educated. If so, the more educated will be ready to accept some wage discount and pay high rents to live in more amenable cities. In contrast, since the less educated are relatively less keen to live in that places, high rents must be compensated by higher wage otherwise a process of "gentrification" activates and as a consequence unskilled people will be found in less pleasant cities or in the suburbs. By exploiting the 1993 and the 1995 special sections on the local quality of life and job satisfaction of the SHIW, our estimations give a very preliminary evidence about the existence of this phenomenon.

Section 7 concludes.

2. Basic evidences about Italian cities

This paragraph is closely related to the work of Glaeser et *al.* (2011). Our choice is essentially motivated by three reasons. First, taking into account the availibity of the data, we would like to create a link with current urban literature and use the latter for comparison. Second, that approach allows us to investigate the demographic structure of cities over the long run, from Unification to today, establishing in this way a sort of continuity with previous studies which focus on Italian urbanism (Malanima, 1998; Bosker et *al.*, 2008 and Percoco, 2013). Third, the historical perspective together with econometrics represent an essential alchemy to grasp the weaknesses and strengths of cities as well as

to interpret and anticipate the changes about future evolution. Yet, the methodology enables to bring out evidences that it is worth using as a guideline in the following pages.

Our cities' database come from the Bank of Italy's *Survey of Household Income and Wealth*. Specifically we extract from the SHIW the municipalities listed in three waves (1986, 1991 and 2000). The LLMs' dataset is obtained by matching each city with the local labor market to which that city belongs. As a result we have 442 cities associated with 277 LLMs (40 percent of the total). The distribution of the sampled cities and LLMs on Italian territory is reported in the data appendix. We combine both the datasets with census data (population, employment, number of workers in manufacturing and number of people with a college degree).[6] Next we start with a discussion of key facts about our sample of cities.

Fact #1: Population patterns have been persistent over long time periods.

A well-known fact in the analysis of systems of cities is the empirical regularity in the size of distribution. There are laws that are supposed to hold universally and over centuries, such as the Gibrat's law, which claims that population growth rates are indipendent of initials levels, and the Zipf's law, the claim that the second largest city is half the size of the largest one, the third largest city is one-third of the size of the the largest one, and so forth (Gabaix and Ioannides 2004, Rossi-Hansberg and Wright, 2007).[7] When it comes to these laws, Italy is not an exceptional country. Bosker et *al.* (2008) and Percoco (2013), by using a large sample of cities over the period 1300-1861, demonstrate that the Gibrat's law, and as a consequence the Zipf's law, is very likely to hold only for larger cities.

The first fact we want to show about our sample of cities is the similarity of population patterns in 1860 and in 2001 as shown in Figure 1.

$$\begin{aligned} \text{Log (pop in 2001)} = \quad & 1.204 + 0.979 \log (\text{pop in 1861}) \\ & (0.403) \quad (0.041) \end{aligned}$$

There are 369 observations and the R^2 is 0.660, which corresponds to a 81 percent correlation. Some persistence is naturally to be expected because of housing durability,[8] but our finding implies

[6] The National Institute of Statistics (ISTAT) obtains LLMs on the basis od the daily commuting flows from place of residence to place of work (ISTAT, 1997). The condition determining their boundaries requires both that at least three quarters of the LLM residents are employed there and that at least three quarter of the LLM employees reside there. Data at LLM level are available from 1971 onward.

[7] Put differently the Zipf's law states that the size distribution of cities is well approximated by a Pareto distribution in the upper tail of the size distribution. The Zipf's law has at its core the Gibrat's law through increases of fixed size that occur proportionately to population (Duranton and Puga, 2013 pag. 48). Gabaix (1999b) shows that if city growth rates obey Gibrat's law (i.e. growth rates are indipendent of current size), then Zipf's law emerges as the limiting size distribution (as long as a lower bound on how far cities can diminish in size is imposed). As growth is scale invariant, so too is the final distribution. The empirical counterpart of Zipf's law reveals that if the total population of a country or region were clustered in one single large city the coefficient on log city size uquals zero, if all cities are of equal size the coefficient would equal minus infinity and finally for Zipf's law to hold the coefficient should be equal 1.

[8] The durability of housing has important implications for city growth since people can muove out of a city whereas houses cannot. When a city experiences a positive shock, more workers are attracted to it and additional housing is built. On the other hand, when a city experiences a negative shock and some workers leave, exisisting housing is not destroyed. More specifically, if housing is durable, its supply will be imperfect- with a steep slope below its current equilibrium level and a flatter slope above this level. This suggests an asymmetry between city growth and city decline. When cities grow, they experience moderate house price increseases and large population changes. When cities contract, they experience large house price drops and small population changes (Glaeser and Gyourko, 2005; Duranton and Puga, 2013).

furthemore that, over this long time horizon, Gibrat's law operates: the change in population is unrelated to the initial popultaion level as shown by the following regression:

$$\log(\text{pop in 2001}/\text{pop in 1861}) = 1.204 - 0.020 \log(\text{pop in 1861})$$
$$(0.402) \quad (0.041)$$

The coefficient on the initial population is not statistically significant (as Gibrat's law requires), however there is a slightly negative correlation between initial population levels and the rate of subsequent population growth, suggesting a tendency towards sprawl.

Fact #2: Population growth persists.

Table 1 shows another important fact about urban growth of Italian cities. The permanence of population levels is accompanied by a permanence of population growth rates over decades. The first two columns of Table 1 show the correlation of population growth rates, measured as the log change of population and the lagged value of that variable. The first column shows results for our entire sample. The second column shows results when we restrict the sample to only those cities that have at least 50,000 people at the start of the lagged decade. Numbers in brackets denote the number of observations.

Column 1 shows that cities that grew in the previous decade also grew in the next decade except for the decade 1981-1991. Indeed the best predictor of whether a city will grow over the next 10 years is whether or not it has grown over the past 10 years. During the Liberal Age, the correlation coefficients range from 0.08 to 0.36. Then, in the decade of WWI the correlation falls, but from the 1920s the pattern resumes again and the correlation has been even higher: the coefficients lie between 0.14 (the first decade of the Fascist Era) and 0.64 except for the unusual 1980s. The pattern of persistence for larget cities is even stronger. The correlation coefficient is always higher for more populous cities than for smaller one, apart from the decades of the WWI, the 1970s and the 1980s.

Glaeser (1994) lists at least three possibile explanations for these correlations. The first is that there are good cities and there are bad cities. The good cities just keep growing and the bad cities keep declining. Specifically, there are profound city-specific effects that determine growth. Second, the presence of other people is one of a concentrated area's biggest attractions despite the congenstion problems. Third, the urban attributes that rose most in their valuation by residents during the past years also rose in value over the next period.

Next, we test if population growth persists over longer time horizons than decades. We regress the log change of population between 1951 and 2001 on the log change of that variable between 1861 and 1951. The result is:

Housing is during but not permanent. It depreciates slowly over time. This suggests another step to the argument above. After a negative shock, some households leave, and housing prices decline, which induces many to stay. Then, over time, the housing stock depreciates and housing supply declines. Since house prices, that is, the market values, of properties may be well below their construction costs, houses that depreciate are not likely to be refurbished. Households will thus slowly leave the city as the housing stock slowly depreciates. Put differently, housing decline is expected to be persistent. Indeed, urban decline one decade is a strong predictor of urban decline the following decade whereas city growth one decade is a less strong predictor of city growth for the following decade (Glaeser and Gyourko, 2005).

Glaeser and Gyourko (2005) also argue that those who stay in declining cities because of low housing prices are likely to be those with the lowest labor market opportunities in case of out-migration. They provide evidence that declines in population are associated with declines in human capital in their sample of cities.

$$\log(\text{pop in } 2001/\text{pop in } 1951) = 0.036 + 0.321 \log(\text{pop in } 1951/\text{pop in } 1861)$$
$$(0.069) \quad (0.099)$$

There are 369 observations and the R^2 is 0.101 which corresponds to a 31 percent correlation. Although the number of observations is low, the correlation became slightly negative for cities that began with more 50,000 inhabitants in 1861 and the persistence vanishes for cities that had more than 30,000 people in 1861 as Figure 2 and in Figure 3 show. Given that decadal persistence is stronger for larger cities, these facts are surprising and suggest that different cites were growing during different epochs, perhaps, because city-specific forces were at work.

Fact #3: Gibrat's law is broken over the period 1971-2001

Fact #1 states that Gibrat's law holds in our sample over sufficiently long time period, from Unification to today. But Gibrat's law doesn't hold for many decades within our sample. Column 3 of Table 1 shows the correlation between the initial logarithm of population and the subsequent population growth over the next decade. Column 4 shows the correlation for more populous cities, those with at least 50,000 people at the start of each decade.

During the first two decades of the Liberal Age, although population growth seems negatively associated with initial population levels, the correlation is not significant at all. This period is marked by Gibrat's law according to which population growth is unrelated with initial levels. During the same period (with the exception of the first decade in the aftermath of Unification) there is a positive and significant correlation between initial population levels and later growth in larger cities, suggesting increased concentration. History helps us to explain these patterns. The development of manufacturing activities, usually classified as 'Industrial Revolution', occurred in Italy with a considerable delay compared to other European countries and the US. Economic historians agree in fixing its beginning around 1870 when there was an increase in the size of Italian firms, an increase in engineering, shipbuilding and construction production and the advent of large chemical industry and energy hydropower. The protectionist policy, adopted by the government in 1887, fostered the development of the textile industry and the steel production. The strong localization of these industries in the North (West), specifically in large cities, favored a cumulative process towards large industrial centers and deepened the gap between industry and agriculture. In fact, the agricultural sector, despite the protection of wheat, suffered a serious crisis. A clear proof of this situation, was the sudden increase in the overseas emigration from the central and southern regions and the abandonment of the countryside in favor of the urban centers.

The process of centralized city growth continues until 1971 (with the exception of the first decade of Fascim Era), and becomes stronger through the Italian 'economic miracle'.

From 1971 to 2001, the correlation between initial population and later growth is negative. The correlation is negatively stronger for the largest cities. This period is not marked by Gibrat's law at all, in contrast it is marked by mean reversion (convergence) as Italians spread out towards less populated cities. This evidence is in line with Glaeser et *al.* (2011) who use a dataset of 1124 U.S. counties but in contrast with many studies of the post-war growth of cities and metropolitan areas in the U.S. and elsewhere (Glaeser et. *al*, 1995; Eaton and Eckstein, 1997; Glaeser and Shapiro, 2003).

Our model below formalizes the channels through which human capital may have influenced the flexibility of the urban structure in Italy. The impact of the industrial orientation of cities is examined as well.

Fact #4: Urban sprawl occurs within the North West in the period 1971-2001.

In the Italian case and since Unification, the North-West has represented a laboratory, a cutting-edge area, whose structural changes (rapid industrialization in the early twentieth century and sudden de-industrialization at the end of the century) have anticipated those of the rest of the country. Now, we focus on this area. Column 1 of Table 2 shows the correlation between the initial logarithm of population and population growth over the subsequent decade.

From 1861 to the eve of the Fascist epoch, there is a positive, but insignificant correlation between initial population levels and later growth. This early period was characterized by rapid structural changes and reflects the ongoing consolidation of the region; as expected Gibrat's law holds.

After the anomalous thirty years period of Fascist dictatorship and WWII, the North-West behaves similarly to the whole sample (Column 3, Table 1), but we can distinguish two well-marked population patterns. We have centralization during the 'economic miracle' and strong urban sprawl from 1971 to 2001. In the latter period the correlation is strongly negative, ranging from -0.22 during the 1970s to -0.43 during the 1980s.

Fact #5: The Industrial Triangle grows until the 1970s.

The Industrial Triangle is the area between Turin, Milan and Genoa. Since Industrial Revolution, particulary after WWII, it has been the backbone of the Italian economy; an area of intense industrial and machinery production. We calculate the distance between the centroid of the Industrial Triangle and the centroid of each city in the sample. We then define proximity to Industrial Triangle as the maximum of 100 kilometers.[9]

Columns 2 of Table 2 shows the correlation between decennial population growth and our measure of proximity to Italy's golden triangle. Between 1871 and 1951, the cities of Industrial Triangle grew uniformly with the correlation ranging from 0.15 during the decade following the Unification to 0.29 in the period 1931-1951. Roads and rail tunnels provided good links through the Alps to European markets. The port of Genoa represented a key commercial hub for inputs and outputs as well. Figure 4 shows the 0.40 correlation for cities within 100 kms of the center of the Industrial Triangle.

The area strongly grows during the economic miracle. The correlation between population growth and the cities belonging to the Industrial Triangle is 0.43 and 0.24 during the 1950s and 1960s rispectively. In those years there was an exceptional wave of immigration. Between 1958 and 1963, in the Industrial Triangle, the residing population soared from 69,000 individuals to about 200,000 individuals. In the same period, in Milan, moved about the 30 percent of southern migrants. In Genoa, population increased by 15 percent in the 1950s. In the period 1960-1963, Turin hosted about 300,000 immigrants from the rest of Italy. Castronovo (1977) writes:

[9] We use ISTAT spatial data and the software R for the calculation.

> No Italian city, in the post-WWII period, experienced so deep transformations as Turin did [...] it became a sort of Detroit characterized by futuristic and shapeless profiles, an advanced industrial society dominated by the automobile monocultur and, at the same time, the third "southern" city of the peninsula. It became a new and incandescent community, animated by the most massive immigration in our history.

The region decline after 1970. The relationship between proximity to Industrial Triangle and population growth disappears in the 1970s, then it becomes negative. There are many explanations in the literature that can help us to shed light on the decline of the golden triangle.
This can be attributable to the impact of massive regional and local policies which forced mobile resources to go to the South. The 4th Siderurgical Center in Taranto, the Alfasud car plant in Pomigliano d'Arco (NA) and the Fiat plant in Termini Imerese (PA) were established in the 1970s (Felice, 2011; Cerrito, 2010). Furthermore, globalization has certainly facilitated the relocation of many manufacturing plants elsewhere and technological progress had reduced the importance of logistical advantage conferred by the Industrial Triangle.

Table 3 presents the basic results on population growth as a function of geographical variables for six different sub-periods. In Part A we regress population growth on the proximity to Industrial Triangle. In Part B we focus on macro-area dummies and exclude proximity to Industrial Triangle. In both cases we control for initial population conditions. Coerently with the facts pointed out by Table 1, from Unification to 1971 cities were getting bigger. The impact of initial level of population is positive and concentration occurred, particularly to cities within the Industial Triangle, in the period 1881-1921. Regressions suggest that (the omitted) North-West grew the fastest during the periods 1901-1921 and 1951-1971. Belonging to the Industrial Triangle or being in the proximity of it had a positive effect on population growth. The explanatory power of the North-West and the Industrial Triangle soared during the 1950s and the 1960s. After 1971, the North-West performed worse than the other macro-areas and the coefficient on proximity to the golden triangle reduces by 80 percent. This presumably reflects the growth of sprawl and the fact that people moved South whose coefficient is the highest.

Table 4 repeats the basic specifications, but now the dependent variable is the employment growth. We collected data from Industrial and Commercial Censuses.[10] The results approximatively mirror those of Table 3. Again, we confirm the fact that the North-West performed worse than the other macro-areas in the period 1971-2001. The estimated coefficients on the regional dummy variables indicate that the fastest growing cities were in the South and in the Islands.

Fact #6: Manufacturing predicts the decline of cities.

Many papers have estimated that a high initial exposure to manufacturing has an adverse effect on the growth of cities and metropolitan areas (Glaeser, Scheinkman and Shielfer, 1995; Glaeser and Saiz, 2004; Simon and Nardinelli, 2002). In contrast, Glaeser, Ponzetto and Tobio (2011) noted that this negative correlation does not appear in county data.

Figure 5.1 shows that as the share of a city's workers in manufacturing in 1951 rises by 1 percent, subsequent population growth rises by 0.15 log points. This positive correlation remains robust if we control for initial population. If we restrict our sample to cities with at least 50,000 people in 1950, the correlation becomes negative. We do the same job for employment growth, as shown in Figure 5.2. A ten percent point increase in the share of manufacturing in 1951 decreases the long period

[10] The first Industrial Census was carried out in 1911, the second one in 1927 and the third one in 1937. The latter reports data only on provincial capitals. Since 1951 the Industrial and Commercial Census has been carried out every ten years.

employment growth by 0.3 percent. The effect becomes 0.12 percent if we control for initial employment.

Columns 1 and 2 of Table 5 examine the relationship between decadal city population and employment growth and initial manufacturing share respectively. In the postbellum twenty-year period there is a strongly positive correlation between growth and manufacturing. However and overall, a high initial exposure to manufacturing is negatively associated with population growth as well as employment growth.

We have data on LLMs starting in 1971. Columns 3 and 4 show the correlations between the share of workers in manufacturing and later growth in the LLMs. Column 3 shows a weak 0.06 correlation between manufacturing share in 1971 and population growth in the period 1971-2001. The correlation is strongly negative if we look at employment growth. Column 4 indicates that a 1 percent rise in the share of manufacturing in the 1971 is associated with a 0.25 percent fall in employment growth between 1971-2001. The relationship remains quite robust if we control for initial level of employment and restrict the sample to the LLMs with at least 100,000 people in 1971.

These results suggest that manufacturing left cities and cities that were more exposed to manufacturing decline.[11] While these correlation are interesting, they have been studied largely by international literature, so we refer to the authors cited above for further details.

Next, our focus is on the relationship between education and growth.

Fact #7: Education predicts employment growth and population decline in the post-war period.

The strong association between human capital and city or metropolitan area population growth has been noted for some time. Glaeser, Scheinkman and Shielfer (1995) show that population growth is positively related to initial human capital where human capital is measured using a wide range of education variables. In a thorough investigation of that relationship between 1970 and 2000, Glaeser and Saiz (2004) conclude that, for an average city, a one percent point higher share of university graduates is associated with 0.5 percent population growth over the subsequent decade. Shapiro (2006), uses the growth as measure of city growth rather than the population growth. He, like Glaeser and Saiz (2004), finds that instrumenting city human capital by the presence of land grant colleges strongly suggests that the effect of education on city growth is causal. Simon and Nardinelli (2002) propose that cities that start out with proportionately more knowledgeable people grow faster in terms of employment either in the long run and in the short run.[12] We now ask whether this positive correlations also hold in our sample of Italian cities. Table 6 shows the correlation between the share of the adult population with college degrees and subsequent population and employment growth.

[11] Many authors have argued that a strong manufacturing sector is a key ingredient for the success of cities. Krugman (1991) noted that firms are not randomly distributed over space, but they tend to be located next to each other. As a consequence a successful manufacturing sector may attract satellite firms for the production of inputs and services and in this way spurring growth. However as Simon and Nardinelli (2002) demonstrate, manufacturing's impact is positive in earlier periods but not necessarily over the long run, particularly in the last decades of XX century. The typical industry's growth follows an S-shaped pattern: rapid growth, followed by slower growth and then decline. Glaeser, Scheinkman and Shielfer (1995) suggest that cities followed the fortunes of the industries they are involved. "*Non-manufacturing activities did not move into cities where manufacturing declined; rather, the population of these cities itself (relatively) declined trhough emigration, and income fell. […] Cities that invested in older types of capital do not replace that capital as it becomes obsolete because (1) existing capital represent a sunk investment and (2) the pre-existing capital "crowds out" newer capital due to the scarcity of land"* .

[12] The main exception is Glaeser, Ponzetto and Tobio (2011). They fail to find a positive association between human capital and subsequent county population growth in the Eastern and Central United States for a few decades in the last two hundred years.

Column 1 part A, shows that there is no association between human capital and population growth. In the long run (1951-2001), as the share of population with college degrees increases by 10 percent in 1951, population growth rises by 0.4 percent, but the coefficient is not statistically significant at all. This is certainly due to the strong heterogeneity of population patterns over decades. In the more homogeneous period 1971-2001 the correlation is negative. A 10 percent rise in the share of graduates in 1971 is associated with a 0.81 percent fall in population growth. This negative effect may be due to mean reversion in population from 1971 onwards. Once we control for initial population, the coefficient on human capital increases to 0.99 and the relationship remains significantly negative (at 1% level). Over shorter periods, there is a positive association between college attainment and population growth during the decades of economic miracle. Then the sign of correlation reverts and it holds in every decades after the 1970s (except for the 1980s) also when we account for the tendency of population to converge to the mean. However, also in the period 1981-1991 the positive correlation disappears if we control for initial population.

Column 2 part A, shows the results for employment growth. In our sample there is a positive correlation between initial education and subsequent employment growth. From 1951 to 2001, by controlling for initial log employment, as the share of population with college degrees increases by 10 percent in 1951, employment growth increases by 0.02 percent (1 percent in the period 1971-2001). Looking at the single decades and controlling for initial conditions, the estimated coefficients for initial university graduates are always positive ranging from 0.011 during the 1990s to 0.10 during the 1970s.

Glaeser and Resseger (2010) suggest that skills have more impact in larger cities. Column 1 part B, focus on the population growth of those cities that begin the decade with at least 50,000 people. Numbers in brackets denote the number of observations. In the long run the estimated coefficients are 0.238 in the period 1951-2001 and -0.092 in the sub-period 1971-2001. In the first case the coefficient is indistinguishable from zero while in the second one it is statistically significant at 1%. Then, the negative association between population growth and human capital remains also if we restrict the sample to more densely inhabited cities. Column 2 part B, looks at the employment growth. From 1951 to 2001, a 10 percent rise in the share of graduates in 1951 is associated with a 1.1 percent rise in employment growth (2.3 percent in the period 1971-2001). When we come to employment, the magnitude of the coefficients is larger than those of the entire sample as suggested by the theory.
During the decades 1950s and 1990s the raw correlation is slightly negative, but the negative sign disappears once we include the initial log employment. These results seem to confim the fact that educated people at the top of the education distribution spur employment growth but have an adverse effect on density also in more populous cities.

The simultaneous negative correlation between education and population growth and positive correlation between education and employment growth is consistent with the view according to which areas with more educated population experience more rapid growth in the quality of life. If skilled individuals are willing to accept some wage discount and pay high rents to live in better cities, then less educated leave cities and move to suburbs or neighboring municipalities to avoid the higher houses' prices. Specifically a process of gentrification may activate.

Now, we presents some preliminary evidence supporting gentrification hypothesis. Column 3, part A, of Table 6 examines the relationship between decadal population growth and the initial share of the adult population with college degrees in LLMs. If the gentrification process story holds, then we expect that education is positively -or negatively weaker than the case of cities- correlated with population growth. This is particularly true if we consider that LLMs are natural labor markets and cities within them are better units of analysis for understanding either amenities or real estate prices.

Column 3 shows that at higher frequencies there is a negative association between college attainment and population growth (with the exception of the 1970s). In the period 1971-2001, a 10 percent rise in the share of graduates in 1971 is associated with a 0.6 percent fall in population growth at the LLM level. Although the correlation is negative, the coefficient is 40 percent lower than the coefficient estimated at city level (0.99). Column 3 part B, focus on the population growth of those LLMs that begin the decade with at least 100,000 people. For those LLMs as the share of population with college degrees increases by 10 percent in 1971, population growth declines by 0.7 percent in the subsequent thirty-year period. At the city level the effect is 0.92 percent. The effects of education on population growth are negatively weaker for LLMs than cities. We interpret this fact as our first indication of the possibity that less skilled population leave smart cities because of increasing rents. Moreover we will try to investigate futher on this point in section 6 of the paper. In the next subsection we sum up all the empirical facts and discuss their implications.

2.1 Interpretation of the stylized facts

One approach to urban areas emphasizes the existence of certain immutable relantionships, such as Zipf's or Gibrat's laws. Bosker et al. (2008) and Percoco (2013) are two examples of this approach applied to Italian cities. Bosker et al. (2008) argue that the main determinants of Italy's city growth are physical geography and political predominance. Percoco (2013) focus on quality of institutions. According to these studies and as Fact #1 shows, the long-run persistence of cities level population implies that Gibrat's law holds in the long run. Duranton and Puga (2004) and Gaeser et al. (2011) note that Gibrat's law holds over sufficiently long time periods because of the accidental balancing of centripetal and centrifugal forces. Our results suggest that centripetal forces dominated during the Liberal age and during the economic miracle, periods characterized by the expansion of industrial cities that formed around earlier commercial hubs (Fact #2 and Fact #3). The North West and the Industrial Triangle grew very quickly in these periods thanks to a strong manufacturing sector that attracted labor force from the rest of Italy (Fact #4, Fact #5 and Fact #6). Centrifugal forces prevailed in the last decades of XX century. Since 1971, Italians have spread out towards less populated cities, the Industrial Triangle has declined and the North West have performed worse than the other macro-areas either in terms of population growth and employment growth (Table 3 and Table 4).

But Gibrat's law does not hold for population (employment) growth at higher frequencies. Our results suggest that after 1971 population converge across cities and less populous urban areas grew more quicky. Then an alternative approach is that urban changes reflect individual responses to changing tastes and technologies. Among others and focusing on the U.S. case, Glaeser and Saiz (2004), Shapiro (2006), Glaeser and Gottlieb (2006) and Glaeser et al. (2011) follow this view. Education predicts employment growth and population decline in our sample of cities. This evidence is particularly true in the period 1971-2001 (Fact #6). Although it is in contrast to much of the U.S. literature (schooling generates population and employment growth) it is compatible with the view according to which areas with more educated population experience more rapid growth in the quality of life. This might occur because more educated individuals spur the growth of consumption amenities in cities in which they reside. For instance, services such as opera and restaurants, physical attraction such as architecture, good schools and hospitals may be available in larger and more skilled cities but not elsewhere. Moreover, skilled cities may allow for the provision of better public goods thanks to the influence of educated people on the political process.

Now, amenities (or disamenities) can be evaluated differently on the level of individual education. More educated people are likely to care more about the quality of life aspects of the place they live: skilled individuals seem to enjoy some urban amenities more than the unskilled ones (Adamson et al. 2004, Glaeser et al. 2001). This idea has found strong empirical support in the Italian case (Dalmazzo and de Blasio, 2011). When the more educated evaluate more the consumption possibilities associated with city size, then an additional implications must hold: skilled individuals have to be willing to accept some wage discount and pay high rents to live in better cities.[13] By contrast, since the less educated are relatively less keen to live in those places, high rents must be compensated by higher wages, otherwise a process of gentrification activates. Column 3 in Table 6, gives us a preliminary indication according to which a process of gentrification activated in Italy during the period 1971-2001.

3. Theoretical Framework

In this paragraph we exploit a spatial equilibrium model to explain why human capital correlates with city growth. We follow the methodology used in Shapiro (2006) and Glaeser and Saiz (2004). This approach allows us to disentangle the mechanisms through which skills generate employment growth, as Fact #7 emphasizes. Specifically the questions we are interested in, are: is Italian cities growth a consumption-led growth or a production-led growth? If amenities drive the employment growth, what is the percentage of growth due to the quality of life?[14]

3.1 Unraveling between production-led growth and consumption led-growth

Suppose an economy partitioned in I non overlapping areas, indexed by i = 1, 2,…., I. Each area is endowed with a specific productivity factor which enters the production function (A_i) and quality of life which enters the utility function (Q_i). Firms are identical and assumed to be perfectly mobile across locations. Representative firm use a Cobb-Douglas technology and produce a homogeneous tradable good at the numeraire price of 1 by using land and labor. The production function in location i is $Y_i = A_i\,(L^F)_i^{1-\alpha} N_i^{\alpha}$, where L^F denotes the quantity of land used in production and N denotes the quantity of labor. Profit maximization and spatial equilibrium imply that the following condition must hold for all i:

$$\frac{\eta W_i^{\alpha} P_i^{1-\alpha}}{A_i} = 1 \qquad (1)$$

where $\eta \equiv \alpha^{-\alpha}(1-\alpha)^{\alpha-1}$. Because of constant returns to scale, firms make zero profit in equilibrium and equation 1 can be interpreted as a free-entry condition in the good market.

Consumers are identical and choose among a set of locations. They have Cobb-Douglas utility over the freely-tradable homogeneous good and land which is the non-traded good. Utility function in area i is given by $U_i = Q_i Y_i^{\mu} (L^c)_i^{1-\mu}$ and it is maximized under the budget constraint $W_i = Y_i +$

[13] Di Addario and Patacchini (2008) find that returns to college in Italy are negatively correlated with the population size of the LLMs.

[14] Note that throughout the paper we use consumption growth, amenities growth and quality of life growth as synonymous.

$P_i(L^c)_i$. Here L^c denotes the quantity of land consumed. Spatial equilibrium requires that the indirect utility funcion must be constant across areas, therefore we have for all *i* and some constant $\overline{U}$:

$$\frac{\gamma Q_i W_i}{P_i^{1-\mu}} = \overline{U} \tag{2}$$

where $\gamma \equiv \mu^{\mu}(1-\mu)^{1-\mu}$.

Equations (1) and (2) determine the equilibrium values of wages and rents as function of (A_i) and (Q_i). They show how the factor prices adjust to make both firms and individuals indifferent between locations. Equation (1) represents the isocost of a typical firm in location *i* and it is a downward-sloping curve in the rent-wage space. Equation (2) is the iso-utility of a typical resident in location *i* and it is a upward-sloping line in the rent-wage space. Given Q_i, an increase in the productivity term (A_i) yields an increase in both wages and rents to compensate the otherwise cost reduction that firms will get. Then, on the one hand more productive firms will pay higher wages; on the other hand, rents rise to equalize utility across space since workers are receiving higher wages. When also the quality of life parameter (Q_i) increases, the iso-utility curve shifts yielding a further increase in rents but not in wages, therefore land will be more expensive in more amenable places.

Area size, defined as the number of local workers, is endogenous. We assume a fixed local supply of land $\overline{L_i}$ which must be equal to the total demand for land. The latter is given by the sum of land demanded by firms plus the land demanded by workers, that is $\overline{L_i} = (1-\alpha)\ Y_i/P_i + N_i(1-\mu)\ W_i/P_i$. Solving the model, we get the third equilibrium condition:

$$P_i = \lambda \frac{N_i W_i}{\overline{L_i}} \tag{3}$$

where $\lambda \equiv \frac{(1-\alpha)(1-\mu)}{\alpha}$. Equation (3) links positively rents and employment: given that the local supply of land is fixed, when the number of workers in an area raises, the price of land increases as well.

Equations (1), (2) and (3) determine simultaneously W_i, P_i and N_i. Our focus is on changes in the productivity level A_i and quality of life level Q_i and these are the only area-specific attributes that we allow to change over time. By totally differentiating (1) and (2) with respect to time and after some manipulations we arrive at the following expressions for the changes in land prices and wages:

$$\frac{d\log(P_i)}{dt} = \frac{\alpha}{(1-\alpha\mu)}\left[\frac{d\log(Q_i)}{dt} + \frac{1}{\alpha}\frac{d\log(A_i)}{dt}\right]$$

$$\frac{d\log(W_i)}{dt} = \frac{(1-\mu)}{(1-\alpha\mu)}\frac{d\log(A_i)}{dt} - \frac{(1-\alpha)}{(1-\alpha\mu)}\frac{d\log(Q_i)}{dt} \tag{4}$$

Given the form of the production function and utility function, α and $(1-\alpha)$ represent the share of labor and land in the firm's cost function respectively, and $(1-\mu)$ is the share of land in the household's budget. Moreover, we assumed that $d\overline{U}/dt = 0$. From equation (3) and by using (4), employment growth can be written as:

$$\frac{d\log(N_i)}{dt} = \frac{1}{(1-\alpha\mu)}\left[\frac{d\log(Q_i)}{dt} + \mu\frac{d\log(A_i)}{dt}\right] \quad (5)$$

Equations (4) and (5) must hold for all areas *i* and they yield standard results in the urban literature. First, increases in urban productivity will raise prices, wages and employment; second, increases in the quality of life or consumption amenities will increase employment and rents, but reduce wages.

Let $H_{i,t}$ denotes the share of human capital in the area *i* at time *t* and let $X_{i,t}$ be a vector of measurable exogenous area characteristics. Assume that

$$log\left(\frac{A_{i,t+1}}{A_{i,t}}\right) = H_{i,t}\,\beta^a + X_{i,t}\delta^a + \epsilon^a_{i,t+1}$$

$$log\left(\frac{Q_{i,t+1}}{Q_{i,t}}\right) = H_{i,t}\,\beta^q + X_{i,t}\delta^q + \epsilon^q_{i,t+1} \quad (6)$$

where $\epsilon^j_{i,t+1}$ for $j = a, q$ is an error term which has zero mean and is orthogonal to $H_{i,t}$ and $X_{i,t}$. From (4) and (5) and by substituting (6) we get

$$\log\left(\frac{N_{i,t+1}}{N_{i,t}}\right) = \left[\frac{1}{(1-\alpha\mu)}\beta^q + \frac{\mu}{(1-\alpha\mu)}\beta^a\right]H_{i,t} + \left[\frac{1}{(1-\alpha\mu)}\delta^q + \frac{\mu}{(1-\alpha\mu)}\delta^a\right]X_{i,t} + \varepsilon^N_{i,t+1} \quad (7)$$

$$\log\left(\frac{W_{i,t+1}}{W_{i,t}}\right) = \left[\frac{(1-\mu)}{(1-\alpha\mu)}\beta^a - \frac{(1-\alpha)}{(1-\alpha\mu)}\beta^q\right]H_{i,t} + \left[\frac{(1-\mu)}{(1-\alpha\mu)}\delta^a - \frac{(1-\alpha)}{(1-\alpha\mu)}\delta^q\right]X_{i,t} + \varepsilon^W_{i,t+1} \quad (8)$$

$$\log\left(\frac{P_{i,t+1}}{P_{i,t}}\right) = \left[\frac{\alpha}{(1-\alpha\mu)}\beta^q + \frac{1}{(1-\alpha\mu)}\beta^a\right]H_{i,t} + \left[\frac{a}{(1-\alpha\mu)}\delta^q + \frac{1}{(1-\alpha\mu)}\delta^a\right]X_{i,t} + \varepsilon^P_{i,t+1} \quad (9)$$

where $\varepsilon^s_{i,t+1}$ for $s = N,\ W, P$ is an error term which has zero mean and is orthogonal to $H_{i,t}$ and $X_{i,t}$ because it is a linear combination of $\epsilon^j_{i,t+1}$. According to Shapiro (2006), expression (7) shows that a positive correlation between human capital and later employment growth can emerge because of some omitted variable of $X_{i,t}$ which itself generates employment growth, because of productivity growth $(\beta^a > 0)$ or quality of life growth $(\beta^q > 0)$. Given data on employment growth, changes in housing prices and wages for a panel of cities, equations (7), (8) and (9) show us how to use the differences in the coefficients from employment, wage and price growth regressions to determine the value of β^a and β^q and how to evaluate the importance of productity and consumption amenities in genereting local growth. The idea is that if a variable (i.e. human capital) is increasing employment and prices, more than wages, this implies that the variable is increasing consumption amenities and therefore

consumption-led growth prevails. If a variable is correlated with increasing employment and wages more than with prices, then this implies that the variable is increasing productivity rather than quality of life. Put differently, production-led growth requires nominal wages and housing prices to raise, while consumption-led growth requires real wages to fall.

Let be $\hat{\beta}_{emp}$, $\hat{\beta}_{wage}$ and $\hat{\beta}_{price}$ the coefficients on human capital in employment growth, wage growth and housing price growth regressions respectively; then we have:

$$\hat{\beta}_{emp} = \frac{1}{1-\alpha\mu}\beta^q + \frac{\mu}{1-\alpha\mu}\beta^a$$

$$\hat{\beta}_{wage} = \frac{1-\mu}{1-\alpha\mu}\beta^a - \frac{1-\alpha}{1-\alpha\mu}\beta^q \quad (10)$$

$$\hat{\beta}_{price} = \frac{\alpha}{1-\alpha\mu}\beta^q + \frac{1}{1-\alpha\mu}\beta^a$$

The system of equations (10) allows us to calculate the parameters β^a and β^q as functions of $\hat{\beta}_{emp}$, $\hat{\beta}_{wage}$ and $\hat{\beta}_{price}$.[15] After some manipulations we arrive at the following relationships:

$$\beta^a = \hat{\beta}_{price} - \alpha\hat{\beta}_{emp} = (1-\alpha)\hat{\beta}_{emp} + \hat{\beta}_{wage} \quad (11)$$

$$\beta^q = \hat{\beta}_{emp} - \mu\hat{\beta}_{price} = (1-\mu)\hat{\beta}_{emp} - \mu\hat{\beta}_{wage} \quad (12)$$

On the one hand this approach allows us to use formulas (11) and (12) to disentangle the productivity effect from consumption effect in the association between employment growth and human capital; on the other hand the model hides the mechanisms through which human capital raises productivity growth and/or consumer amenities as shown by equations (6). For example, skills may generate growth through innovation and the creation of new technologies. Alternatively, human capital may drive growth because of increasing spillovers. Both these theories predict that education-growth connection arises from the increase in the parameter A_i, so they are empirically indistinguishable.[16] Yet, since urban amenities may to do with a variety of factors, ranging from workplace conditions to job satisfaction, from traffic congestion to shopping possibilities, it is very hard to understand a priori which aspects people value and as a consequence it is difficult to make clear how the quality of life channel works. However, we try to shed light on these points throughout the paper.

4. Results

Empirical results are presented in two blocks. In the first one we stress on the relationship between human capital and employment growth and test its robustness. Once assured that a link

[15] Note that system (10) is overdefined because there are 3 equations and 2 unknows. In fact $\hat{\beta}_{price} = \hat{\beta}_{emp} + \hat{\beta}_{wage}$.

[16] Glaeser, Ponzetto and Tobio (2011) present a model of regional growth, where education increases the level of entrepreneurship. They argue that human capital spillover occur at the city level because skilled workers produce more product varieties and thereby increase labor demand. Glaeser and Saiz (2004), by using patent data, suggest that human capital may matter because it makes people more creative.

between skills and growth exists, in the second block we measure the extent to which this connection stems from productivity or consumption effects.

4.1 Employment growth-education relationship

We focus on the period 1971-2001 and our meausure of city growth is the log change of employment between census waves. Our territorial unit of analysis are both LLMs and cities. As highlighted above, LLMs are self-contained labor markets and therefore labor mobility is very low, as required by spatial equilibrium concept. Because of this reason, LLMs are increasingly used as the standard unit of analysis in the urban literarure (Rosenthal and Strange, 2004; Di Addario and Patacchini, 2008; Croce and Morettini, 2011). On the other side, cities within them are a better unit of analysis for understanding either amenities or real estate prices. We obtain a balanced panel for 1971, 1981, 1991 and 2001 for 442 cities by combining the SHIW database with census data. We chose the LLMs that constitute our dataset by associating each city to the LLM that city belongs. As a result we have 442 cities associated with 277 LLMs (40 percent of the total). Data on population and employment at LLM level are collected from the *Atlante Statistico dei Comuni* . The Data Appendix describes the sources of all variables.

Table 7 and Table 8 report estimates of equation (7) for LLMs and cities respectively over three periods (the 70s, the 80s and the 90s). We focus on the coefficient on the log of the percent college graduates, which should therefore be interpreted as the elasticity of the employment growth on this measure of human capital. All regressions include decade-specific fixed effects and allow each geographic unit's standard errors to be correlated over time.

Regression 1 shows the impact of education on growth in a random effects panel estimation which controls for initial employment and time dummies. In the case of LLM-level regressions, a 10 percent increase in the share of college-educated residents is associated with an increase in the employment growth rate of roughly 0.9 percent. In the city-level regressions (Table 8), the effect of college education is smaller. A 10 percent increase in college graduates increases the expected growth rate by 0.6 percent. Initial employment is negatively related to later growth, suggesting mean reversion.
In regression 2 we control for a wide set of urban features, i.e. region fixed effects, sector specialization and age-distribution. Firstly, regional dummies should capture all-time invariant geographic variables as well as those regional policies that change slowly over time. Such variables are particularly relevant within the Italian sample, whose economic development is strongly dependent on historical political fragmentation in region-wide states. Secondly, we keep into account for sector specialization, by controlling for the share of workers in manufacturing, services and trade[17]: such controls enable us to take into account for industrial orientation of the area which, as already previously shown in our descriptive evidences, is a strong predictor of urban dynamics within the time-span under analysis. Finally we control for age-distribution by adding the initial share of population in the following cohorts: 0-19, 20-34, 35-44, 45-54 and 55-64. The latter variables are useful in order to identify whether the impact of education on growth simply reflects the larger presence of younger people which attained higher education level or, symmetrically whether lower education stemmed from a larger share of elderly residents.

[17] In our sample these occupational catagories represent roughly 60% of total LLM employment and 70% of total city employment in 1991.

By including these variables, the coefficient on the college educated remains strongly significant, but decreases by around 20 percent in the LLM-level regression; in contrast the coefficient remains stable at the city-level. LLMs with substantial shares of services and trade grow more quickly. At the city-level, the share of workers occupied in services seems to be negatively correlated with later growth, although this relantionship is never statistically significant. This occurs because, within the city, the share of skilled individuals and the share of workers in services are strongly correlated. In our sample the correlation between these two variables is 0.80. In fact, when we exclude human capital from the regressions, the impact of services on empoyment growth becomes positive. For both cities and LLMs, panel regressions suggest that manufacturing increases employment growth in contrast with the empirical fact #6. To solve this puzzle, in regression 3, we allow the coefficient on manufacturing to differ over time. As such, differences in our estimated coefficients on the interaction of manufacturing and decade should be interpreted as the extent to which the coefficient on average manufacturing has decreased over time. At LLM (city) level, our results show that the importance of manufacturing in driving employment reduced by 0.10 (0.06) between 1981 and 2001. Column 3 confirms another important fact: between 1971-2001 the North-West grew slower than the other macro-areas, as seen in Table 4.[18]

Regression 4 shows that the effect of education on growth becomes statistically insignificant when we control for city or LLM fixed effects. These dummies address the possibility that skilled individuals are just proxying for omitted time-invariant characteristics that spur area growth. As Glaeser and Saiz (2004) point out, including fixed effects is asking a great deal of the data because the estimated coefficient comes from changes in the share of college educated over time within the city or LLM. Since the correlation coefficient in the share of graduated in 1971 and 1991 is 92 percent across cities and 93.3 percent across LLMs, we are not surprised by the zero impact of education on later growth. Moreover, we note that, although fixed effects eliminate most of the variation in skills across space, the coefficient on human capital for LLMs remains positive.

In regression 5, we keep fixed effects up but now we look at those LLMs that begin the decade with at least 100,000 people and those cities with more than 50,000 inhabitants. Glaeser and Ressenger (2010) argue that skills have more impact in more populous areas. Human capital externalities are most likely manifested in cities with the densest concentrantion of people. The coefficient on human capital are estimated as 0.124 for the LLMs and 0.108 for the cities, in both case statistical significant at 1 percent and well higher with respect to the first three specifications.

In Column 6 we use as measure of human capital the share of college graduates in 1951. This choice aims at reducing the upward bias of the effect of education on employment growth that may arise from reverse casuality. In fact, one concern is that the distribution of colleges across cities may reflect expected changes in the local economy. Suppose for example that in 1971 people were able to correctly forecast which cities will experience the fastest economic growth in the subsequent decade. To the extent that highly educated people are more willing to move than unskilled, it is possible that the concentration of colleges in a given area in the initial year, may reflect their expectations about future growth. Clearly this hypothesis is less likely to hold by using the share of educated in the aftermath of WWII. If so, a 10 percent increase in the share of colleges in 1951 is associated with an increase in the LLMs' decadal employment growth of 0.3 log points (0.8 in cities).

[18] In column 3 the time varying manufacturing share control is associated with macro-region dummies. Nevetheless its major findings are confirmed also with region dummies.

Although our attempts to address endogeneity issues, it is still possible that the distribution of graduates in 1951 is itself endogenous and then correlated with the error term. Most studies in regional science and urban growth suggest that predetermined variables such as the presence of colleges prior to WWII may be exogenous to recent events (see Moretti, 2004a). Unfortunately, population censuses do not report data on education attainment before 1951. We obtain data on the number of students enrolled in a high school in 1931 for 161 large cities from the tapes of the *Annuario delle Città Italiane* and we use the share of the percent share of high school enrollment as our proxy of human capital before that year. Column 7 (available only for cities) presents the results by using this measure of human capital as right-hand-side regressor.[19] Magnitude and significance of the coefficient on education remains undisputed.

Finally, in Column 8, we follow Moretti (2004a) and use our proxy of human capital in 1931 as instrument for the share of college graduates. If we believe that the share of high school enrollment in 1931 is orthogonal to the error term, then a 10 percent point increase in the high school enrollment per capita increases the decadal employment growth by, approximately, 1.2 percent.[20]

On the basis of the findings presented above we conclude that the concentration of highly-educated people in a given urban area is a strong predictor of future employment growth. This relationship is robust controlling for a wide set of regional, demographic and sector characteristics. When taking into account for full-observation fixed effect, i.e. excluding any variation across different areas, this relationship is still consistent for areas above a minimum dimension threshold. Finally, we instrument for education levels which date back to 40 years before our analysis time-span: this is expected to rule out biases due to causality and strongly mitigate the case for remaining omitted variables. The residual sources of endogeneity in the estimation of the causality between education and growth could be only due to long-term historical features which have impacted on long-term education patterns and employment growth in the last decades of the twentieth century but are orthogonal with initial employment level, regional characteristics, demographic-age structure and industrial specialization, which we regard as relatively negligile. Therefore our interpretation is that significant causality channels stemming from education to growth exist within our sample of Italian urban areas.

4.1.1 Employment growth-education relationship: Robustness checks

In this subsection, we examine the robustness of the human capital-growth association to a number of alternative specifications. We begin with cities and then we focus on LLMs. Our main comparison are the random effect specification including regional and age-coorts controls (col. 2 of Table 7-8) and the fixed effects specification for areas above the population threshold (col. 5 of Table 7-8).

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[19] In order to obtain the share of college educated at the LLM level in 1951, we aggregated the data for cities into their respective local labour markets. In contrast, we are not able to calculate that variable prior WWII, so columns 7 and 8 are missing in Table 7.

[20] In the first-stage estimates, the effect of human capital in 1931 on the share of colleges in 1971, 1981 and 1991 is 0.261 with a standard error of 0.025 suggesting that education prior WWII is a strong predictor of the distribution of the graduated across cities in the most recent years. When we regress the log of the percent share of college educated on the log of the percent share of high school enrollment in 1931, the coefficient becomes 0.375 with a standard error of 0.033. The F-statistic is 127.47 and the F-test reject the null hypothesis that the coefficient in the model is zero with a significance of 1 percent. According to the thresholds of Stock and Yogo (2005), we can be assured that weak instruments issues do not apply. Note, moreover, that in the specification 8 we do not include fixed effects because our instrument would be absorbed by those effects.

Column 1 of Table A.1-A.2 in the appendix A repeats the random effects specification by including additional controls. Most studies of local area growth in the post WWII period have found that city amenities such as restaurants and hotels, number of museums and recreational service establishments are likely to be provided in high human capital areas and as a conseguence this may encourage employment growth in those areas. We also include the number of membership organizations as a proxy of social capital. By focusing their attention on Italian cities, Albanese and de Blasio (2014) present evidences that social capital (proxied by the voter turnout) is steadily correlated with employment rate and that this reflects some causality running from the former to the latter. If more educated people foster growth by increasing social capital, then it becomes a potential confounding factor in the education-growth relantionship.[21] Specification 1 shows that after adding these controls, the impact of human capital remains robust. In addition to membership organization, in column 2 of Tables A.1-A.2 we consider electoral participation as an alternative measure of social capital. Even if electoral participation might be correlated with factors like political patronage which are actually negatively correlated with civism, still empirical literature have confirmed it as a relevant proxy for social capital. As in the previous regression, while controlling for social capital indicators does not improve the predictive power of the specification, it does not affect the robustness of the impact of human capital. As a third robustness checks we control for the interactions between year and regional dummies: this would remove any potential endogeneity resulting from time shock affecting areas belonging to the same region, like changes in regional policies or shock affecting sectors in which a region is specialized in. Results in col. 3 of Tables A.1-A.2 show that the education-growth relationship is still robust to year-regions controls. As a fourth robustness check (col. 4), we choose to take into account for local labor market conditions by controlling for the logarithm of population levels: as we already control for the logarithm of employees, this specification would be basically equivalent to a one which controls for both occupation rates and levels. Even in this case, the estimation of education coefficients is basically unaffected.

We now move to control for the robustness of the fixed effects specification: we verified that graduates levels across time yields a significant impact for areas above a given size-threshold. Nevertheless, as the choice of 50.000 (100.000) inhabitants as a minimum city (LLM) level could be considered as arbitrary: therefore we conducted a sensitivity analysis applying different levels of cut-off, to test whether the same relationship persists. In col. 5-6 of Table A.1 (A.2) we applied 45.000-55.000 (90.000-110.000) cut-off levels: both in cities and in LLMs our main results persists. Generally speaking, lowering the cut-off level would let in the sample smaller and smaller areas, while raising would shrink the sample rendering it less and less statistically relevant. Nevertheless, we still found that the education-growth relationship keeps statistically significant at 5 percent level in the 40.000-100.000 cut-off interval for cities and in the 70.000-130.000 for LLMs (results are not reported in tables).

Applying a population cut-off would make the panel unbalanced, as an area might be below it at first available year but overcome it in the last one: in order to check it we choose to apply it to the population level in 1981 as a unique cut-off level for all the years, by selecting cities (LLMs) which in that year had over 50.000 (100.000) inhabitants: as shown in column 7 of both robustness tables, while the LLMs coefficient is pretty stable w.r.t. the one estimated in col.5 of the main table, the cities goes up to 0.152. As a final check, we run the instrumental variable estimation adding the controls of age-

[21] Note that the other proxies of social capital suggested by Putnam (1993) are: membership in mutual aid society; membership in cooperatives; strength of mass parties; and the longevity of local associations. Glaeser and Saiz (2004) use the number of membership organizations as a measure of social capital in MSAs.

coorts, still finding a significant coefficient for the causal estimation of the education-growth relationship (Table A.1 col. 8).

In the end, all performed robustness analysis support the view that the correlation between education and future city growth is attributable to a causality stemming from the former to the latter.

4.1.2 Heterogeneity in employment growth-education relationship.

Until this point, our empirical estimates implicitly assumed that the human capital's predictive power on city growth was homogenous across both time and space. In this sub-chapter, we relax this assumption, in order to detect whether the expected impact of human capital might differ within our panel-sample.

Firstly, we try to investigate about time-heterogeneity, i.e. whether the impact of human capital has changed throughout the years. Therefore, we generate interactions between graduates share with year dummies, within the framework of the first two specifications in Table 7-8: results have been shown in Table 9-10, col 1-2 for both LLM and cities. It is quite straightforward to notice in all the specification that the employment growth-education relationships is increasing across time, the strongest effect corresponding to the employment variation between 1991 and 2001 (whose dummy-interaction is omitted). This is consistent with both our prior related literature, which underline the increasing role of knowledge esternalities connected with technological development: as Moretti (2013) points out, in the last decades of the XX century human capital has progressively substituted physical capital as the best predictor of future urban economic growth. Furthermore, the fact the time-heterogeneity is stronger for cities might be a hint about the increasing role for consumption channel growth, i.e. that the demand for location-amenities has increased throughout the years, causing stronger growth in highly educated municipalities rather than local labor markets.

A second potential source of heterogeneity could concern geographic location: Italy is among the European countries which show the strongest regional heterogeneity in terms of economic development, a fact which stems from different long-run patterns of political division. We would like to investigate whether such differences might affect the relationship between human capital and employment growth, with a specific focus on the long-standing North-South divide. In order to do so, we interact human capital coefficient with a dummy for cities/LLMs belonging to Southern regions[22], reporting both the specification with yearly and with full-areas controls (col. 3-4 in Table 9-10). In all the specifications this interaction result to be significantly negative, suggesting that the education-growth relationship is much weaker in Southern Italy urban areas. There are several potential explanations to such fact. Firstly, we may think about measurement error of the dependent variable, given that Southern Italy is characterized by a larger share of underground economy, i.e workers, or that the quality. Secondly, productivity spillover might not work properly: in our theoretical framework, education spurs growth by increasing productivity which in turn raises up wages and therefore attracts new workers. As high public sector presence have worked as safety net in poorer regions like Southern Italy, we suspect that public employment and policies might concentrate in areas characterized by lower productivity, thus being a confounding factor in the productivity-wage relationship.

4.2 Production-led growth or Consumption led-growth?

[22] The "South" dummy encompasses cites/LLMs belonging to the following regions: Abruzzo, Molise, Campania, Puglia,Basilicata, Calabria, Sicilia, Sardegna.

At this point, we can conclude that a correlation between human capital and growth exists. We now use the theoretical framework to measure the extent to which the connection between skill and growth strems from productivity or amenity effects. The model suggests that if human capital is increasing employment and prices, more than wages, this implies that the variable is increasing consumption amenities and therefore consumption-led growth prevails. If human capital is correlated with increasing employment and wages more than with prices, then this implies that the variable is increasing productivity rather than quality of life. In the Italian case, Dalmazzo and de Blasio (2011) use individual-level data to analyze the impact of agglomeration on both production and consumption. They find evidence of a substantial urban rent premium, while they do not find support for an urban wage premium. As a conquence they conclude that urban agglomeration is predominantly a source of positive amenities for residents rather than productivity advantages. Di Addario and Patacchini (2008), by using micro-data from the SHIW, test whether wages vary with urban scale. One of the result they find is that college graduates living in the largest LLMs are subject to a 0.4-0.8 percent wage reduction and conclude that this apparent paradox can be explained in a quality-of-life framework.

Differently to these studies, our focus is on changes over time, not on the level effects. So to address these changes we need to look at housing price growth and at wages growth at the LLM and at city level. In order to measure hourly wage series and house value series we follow the methodology used by Shapiro (2006) and by Gabriel and Rosenthal (2004). We estimate both the house value and the rental price of houses since is not clear *a priori* which market is preferable as a means of measuring differences in the implicit price of land.

To construct the house value series, we extract from the SHIW the value of all real estate in the years 1986, 1991 ad 2000. The SHIW reports city codes only from 1986 onwards, so we are limited to use 1986 as starting point. We restrict our sample to only dwellings and it was trimmed at the 1st and 99th percentile of the distribution of dwelling value. Then we regress the log of reported dwelling values on dummies for cities and as well as a set of controls for dwelling characteristics.[23] The controls we use are surface in square meters, an indicator variable equal to one if two or more bathrooms are available, an indicator variable equal to one if an heating system is available, the year built, dummies for dwelling location, dummies for dwelling category and dummies for use status. We run these regressions separately for each year, so we end up with three house value cross-section series for the years 1986, 1991 and 2000. For each year, we extract the coefficients on cities to be used as estimates of local differences in house values.

In order to obtain rents in cities in 1986, 1991 and 2000, we regress the log of annual rent of all dwellings in the sample in each year on dummies for cities and the set of controls described above.

To measure local productivity, we construct the hourly wage series as follows. We extract from SHIW all workers of age between 15 and 65 in the years 1987, 1991 and 2000.[24] Hourly wages are calculated by dividing the annual earnings by the total amount of hours worked in a year. The sample is trimmed at the 1st and 99th percentile of the distribution of hourly wages. We then regress the log of the hourly wage for each individual on dummies for each city, age and its square, dummies for civil status, educational attainment, sector of economic activity and occupational category. Observations with missing values of the controls were dropped. We estimate separated regressions for each year, so we ended up with three wage series for the years 1987, 1991 and 2000.

[23] Appendix B.1 reports additional details about the controls used.

[24] In the case of wages, we use 1987 as starting point because the variable "hours worked" is not available for 1986. Appendix B.2 reports a detailed description on how we get wage series.

Relative house value, rents and hourly wage levels in LLMs are obtained by performing the same procedure used in the case of cities. The only difference is that we employ dummies for LLMs rather than for cities.

Table 11 lists the 5 highest and lowest house price and wage city-fixed effects in 1986, 1991 and 2000.[25] Naturally, we understand that these coefficients will be biased if there are some omitted characteristics of the workers or the dwellings in the sample. To show that our estimates of local differences in house values, rents and wages are not a mere artifact and as a check on the potential of such a bias we exploit different sources of data. *Il Reddito nei Comuni Italiani* from 1981 to 1987 published every two years by the Banco di Santo Spirito contains the per capita income of all Italian cities. We collect data for the year 1987. For 269 cities for which the estimated wage coefficient is available, the correlation between these two measures is 0.63 in 1987 (statistically significant at the 1 percent level).[26]

Table12 and Table 13 report coefficients from regressions of house value, rental price and hourly wage growth on the log of the percent college graduates for LLMs and cities respectively. Growth is measured as the log change in LLM and city fixed effects. We standardize this to be a ten-year growth rate in the 1981-2001 period, so we end up with a panel over two-periods (the 80s and the 90s). Dummies for time period are included in all specification and standar errors are adjusted for correlation of errors within LLMs and cities.

Regressions 1-3 of Panel A and B in Table 12 show the impact that initial human capital has on later housing value and rental price appreciation at the LLM level. The magnitude of the effect remains robust between regression 1 and regression 2; in the latter, regional dummies and the variables we used in Table 7 are included. Regression 2 suggests that a 10 percent increase in the share of college-educated at the LLM level is associated with an increase in the housing value of 1.34 percent over the next decade (3.6 percent in the case of rental price). The strong negative coefficients on both the lagged house value and rental price highlight that there is a large amount of mean reversion across LLMs: high price areas tend to come back to their historical mean. In regression 3 we add LLM fixed effects. The impact of human capital lose is significance on house value growth; in contrast the effect on rental price growth remains statistically significant at 5 percent level.

Specification 4 looks at LLMs with at least 100,000 residents in the initial year and in regression 5 we use the share of colleges in 1951 as measure of human capital. Education enters significantly and its coefficients remains stable.

Panels A and B in Table 13 look at cities and the results essentially reproduce those we find for LLMs with the exception of the rental price regressions which show smaller coefficients.

Panel C in Table 12 examines the connection between wage growth and human capital. At the LLM level, we fail to find a systematic and significant relationship between initial human capital levels and later growth in wage. Furthermore, we note that the association between the percent share of college-educated and wage growth becomes negative when we control for LLM fixed effects, in line with the results in Di Addario and Patacchini (2008). The point estimate remains negative also when we

[25] Results for LLMs are available upon request.

[26] The modest correlation between wage and income may be due to the differences between the two measures. Wages are remuneration for work and are thus a good proxy for local labor productivity. Income is a composite measure that includes wages plus capital gains, rents, transfers and self-employment income and might have little to do with local productivity, in the sense that income is less geographically dependent. In fact a lot of people, although live in one city, make their money elsewhere.

focus on more densely inabitated LLMs (with more 100,000 residents) although the impact is not statistically significant as shown by Column 4.

Panel C in Table 13 reproduces panel C in Table 12. Growth in wage tends to be higher in cities with greater concentration of college-educated residents: a 10 percent increase in the share of college graduates corresponds to a roughly 0.3-0.5 percent increase in wage growth. The coefficient on schooling becomes not statistically significant when we include city fixed effects. Just in the case of housing prices, there is a substantial mean reversion in income. This means that, during the 1980s and 1990s, income growth was lower in cities that started with higher income levels.

Summing up, Table 12 and Table 13 reveal two notable facts. First, growth in house values, rents and wages tends to be higher in cities with higher share of skilled individuals. Our findings seem to make it clear that higher level of education increase both the employment of cities and LLMs and the price that these workers is paying for living near others of similar educational level. Second and the most important for our purposes, the impact of human capital on the housing price measures is four time as large as the impact on growth in wages. This result supports the view according to which education is a source of positive amenities and as a consequence growth in quality of life may be playing an important role in the association between human capital and employment growth.

4.2.1 Calibration of the model

Next, we will try to quantify to what extent the employment growth-education relationship is due to productivity-led growth or amenity-led growth. In order to achieve this goal we need to calculate the value of the parameters β^a and β^q which capture the impact of human capital on growth in wage and quality of life. As shown by equations (11) and (12), this procedure requires to set $\hat{\beta}_{emp}$, either $\hat{\beta}_{price}$ or $\hat{\beta}_{wage}$ and two other parameters: the labor's share of output (α) and the share of spending on housing in the consumer budget $(1-\mu)$.

We begin with LLMs and then we focus on cities. In Table 7, the coefficient of human capital on employment growth ranges from 0.03 to 0.12. We choose the midpoint 0.08 as value of $\hat{\beta}_{emp}$. Panel A in the Table 12 shows that $\hat{\beta}_{price}$ oscillates between 0.05 and 0.15, as such we fix it to 0.1. The estimates of $\hat{\beta}_{wage}$ range from -0.25 to 0.03 (Panel C, Table 12). We focus on the positive values of $\hat{\beta}_{wage}$ and therefore we set it to 0.03. Note that this calibration is in line with the prediction of the model according to which $\hat{\beta}_{price} = \hat{\beta}_{emp} + \hat{\beta}_{wage}$.[27]

While the growth literature agrees to set the parameter $\alpha = 0.75$ -that is a labor's total share of output that includes the return to human capital- more debatable is the value of the parameter $(1-$

[27] In order to set the parameter $\hat{\beta}_{price}$, theoretically, we may refer to both the rental price regressions and house value regressions. Despite this, we chose to fix this parameter by using the estimates where the dependent variable is the house value (Panel A) for two reasons. First, in the SHIW, rents depend on the subjective evaluation of the interviewed. In fact, in the case the latter is the property owner but the dwelling is not rented or it is the family residence, SHIW reports the interviewed's best estimate for the rent she could charge (see appendix B.1 for details). Second, Glaeser (2008) argues that the problem with rents is that renters tend to be quite special and they live in housing stock that is often quite very unrepresentative of the city as a whole. Renters live overwhelmingly in multi-unit dwellings while owners live in single-family dwellings. This means that they live in very different parts of the city on average. On account of these considerations, we believe that the house value is a more reliable variable than the rent.

μ).[28] Given the Cobb-Douglas form of the utility function, the expenditure function is $(Q_i, P_i, \overline{U}) = \frac{\overline{U} P_i}{\gamma Q_i}$. Taking logs and differentiating w.r.t. P_i yields:

$$\frac{d \log (E(Q_i, P_i, \overline{U}))}{d \log (P_i)} = (1 - \mu) \tag{13}$$

where we assumed that Q_i remains constant. Equation (13) suggests two ways to estimates the share of spending on housing. First, we can use the data in the SHIW and regress the log of the consumption expenditure on the log of housing price. By using this strategy for the year 2000, we estimate that the elasticity of the housing price on overall expenditure ranges from 0.31 to 0.36 percent. The model we have used above assumes that all goods other than land (housing) are traded on a national market; actually the parameter $(1 - \mu)$ represents the impact on the consumer budget of all goods that are produced using land as an input. Therefore those elasticities can be seen as a lower bound. In the second strategy, we regress the log of the FOI price index on the log of the rental price. Here, the idea is that price indices are supposed to measure the amount of money needed to equilibrate utility levels across cities; as a consequences they can be interpreted as expenditure functions. Our results suggest that, in this case, the elasticity ranges from 0.33 to 0.43. Overall, different attempts to infer the share of spending on non-traded goods confirm that this measure lies between 0.31 and 0.43.[29]

$\hat{\beta}_{wage}$, $\hat{\beta}_{emp}$ and $\hat{\beta}_{price}$ range in a relative narrow band so we chose to focus on point estimates over the extremes; in contrast our results seem sensibile to the choice of the value of $(1 - \mu)$, therefore we report our findings by using both the values of this parameter. As we said above, β^a and β^q capture the impact of human capital on growth in productivity and quality of life, respectively. Equation (7) shows that the total impact of human capital on employment growth is $\frac{1}{(1-\alpha\mu)}(\beta^q + \mu\beta^a)$, as a consequence the fraction of the employment growth effect that is due to quality of life growth is $\frac{\beta^q}{(\mu\beta^a + \beta^q)}$.

Table 14 presents the results of this exercise. When $(1 - \mu)$ is 0.31 and we use $\hat{\beta}_{wage}$, the connection between human capital and employment growth is explained by only 10 percent by quality of life growth. This percentage increases to 37 percent when the share of spending on housing in the consumer budget is at its upper bound of 0.43. These percentages are rispectively 27% and 41% when $\hat{\beta}_{price}$ is used for the calculations.[30] Overall, our findings indicate that the bulk of the skill-growth connection at the local labor market level comes from the fact that human capital predicts productivity growth rather than spurring amenities consumption.[31]

What is the underlying mechanism that links education and productivity? Marshall (1980) and Jacobs (1969) argue that productivity gains may be generated by the transfer of knowledge arising from

[28] Raitano (2014) estimates that the share of spending on housing oscillates from 10 to 43 percent according to the income decile we are referring to. He suggests that these figures hold if mortgage payments, utilities and maintenance expenses are taking into account. Shapiro (2006) estimates that the share of spending on housing ranges from 0.22 to 0.32. Glaeser and Saiz (2004) find that this parameter oscillates between 0.21 and 0.29 and choose to fix it to 0.25.

[29] See appendix B.3 for details.

[30] Theoretically, the values of β^a and β^q should not change when either $\hat{\beta}_{wage}$ or $\hat{\beta}_{price}$ are used to determine their values (see equations (11) and 12)). Empirically this occurs because our calibration does not satisfies perfectly the relationship $\hat{\beta}_{price} = \hat{\beta}_{emp} + \hat{\beta}_{wage}$.

[31] This result is in line with Dalmazzo and de Blasio (2005). Based on 238 LLMs, they show that human capital generates relevant externalities on firms' productivity.

the greater intensity of communication between agents, which generates knowledge spillovers favoring innovation (technological spillover) and increasing the speed of learning (intellectual spillovers). In this context, Porter (1990) argues that knowledge spillovers in specialized, geographically concentrated industries stimulate growth by fostering the pursuit and rapid adoption of innovation. He gives examples of Italian ceramics and gold jewerly industries, in which hundreds of firms are located together and fiercely compete to innovate since the alternative to innovation is collapse. We can test this channel by using data on patents at LLM level. Specifically, we expect that in those LLMs with more highly educated people, rapid interfirm movement of highly skilled labor which allows ideas to be quickly disseminated among neighboring firms as well as the sharing of knowledge and skills between workers that occurs through both formal and informal interactions lead to faster techlogical innovation and this explains the connection between LLM growth and human capital.

Now, we focus on cities. Cities within LLMs are smaller and a better unit of analysis for understanding either amenities or real estate prices, but they are part of the same labor market. If we assume that wages are the same across cities belonging to the same labor market, then according to the model used above and as argued by Glaeser and Saiz (2004), the spatial equilibrium condition for consumers (2) becomes $Q_i P_i^{-(1-\mu)} = const$. This expression states that, given wages, rents must adjust to equalize utility in all occupied cities within a given labor market. In other words, the price of housing will be higher in more amenable places. Solving the model, this assumption yields:

$$\log\left(\frac{N_{i,t+1}}{N_{i,t}}\right) = I_{LLM}^{N} + \left[\frac{1}{(1-\mu)}\beta^{q}\right] H_{i,t} + \left[\frac{1}{(1-\mu)}\delta^{q}\right] X_{i,t} + \nu_{i,t+1}^{N} \qquad (7)'$$

$$\log\left(\frac{P_{i,t+1}}{P_{i,t}}\right) = I_{LLM}^{P} + \left[\frac{1}{(1-\mu)}\beta^{q}\right] H_{i,t} + \left[\frac{1}{(1-\mu)}\delta^{q}\right] X_{i,t} + \nu_{i,t+1}^{P} \qquad (9)'$$

where I_{LLM}^{N} and I_{LLM}^{P} are LLMs dummies in the employment growth and price growth regressions respectively. Given the Cobb-Douglas form of the utility function, equations (7)' and (9)' predict that the impact of schooling on employment growth and on rents growth should be the same.

Table 15 reports coefficients from regressions of house value, rental price and employment growth on the log of the percent college graduates for cities controlling for the average growth rate of the local labor market and the industrial orientation of the city. The first thing to note is that, in contrast to the theoretical prediction, the impact of human capital on the housing price measures is about four time as large as the impact on growth in employment. Second, if we follow the same line of reasoning as in the case of LLMs, then we have that $\hat{\beta}'_{emp} = \hat{\beta}'_{price} = \frac{\beta^{q}}{(1-\mu)}$. This means that the effect of the quality of life on employment (price) growth in cities within the same labor market is equal to $(1-\mu)$, that is to the share of money individuals spend on housing. Specifically, according to value of $(1-\mu)$, we have that quality of life explains either 31 or 43 percent of employment growth at the city level.

Overall, we can conclude that although productivity-led growth dominates at both LLM and city level, our findings support the view according to which consumption externalities play an important role in driving the association between human capital and subsequent employment growth in cities. Indeed, when $(1-\mu)$ is set to 0.31, the consumption-led growth explains only the 10 percent of the connection education-employment growth at LLM-level; in contrast quality of life growth

represents the 31 percent at the city level. If $(1-\mu)$ is fixed to 0.43 the percentages are respectively 41 and 43.

5. The North-West case: testing the reinvention hypothesis

Since Unification, the North-West has represented a laboratory, a cutting-edge area, whose structural changes (rapid industrialization in the early twentieth century and sudden de-industrialization at the end of the century) have anticipated those of the rest of the country. A good part of Italy's secular convergence toward more advanced countries occurred between 1950 and 1973. In this period, went down in history as 'economic miracle', Italian GDP per person income rose from 38 to 64 and from 50 to 88 percent of, respectively, that of the United States and United Kingdom. In that process of catching-up, there is little doubt that North-West economy had the leading role. This phase of great prosperity began to wane since the '70s.

Specifically, During the Liberal age and during the decades of the economic miracle, the North-West and the Industrial Triangle grew faster than the rest of Italy both in terms of employment and population (Table 3 and Table 4). The high concentration of manufacturing industries and the proximity to the European markets made it possible for this region to prosper and attract workforce from all over Italy. But in the period 1971-2001 something changed. The empirical fact #5 suggests that employment grew much more sharply in the rest of Italy than in the North-West. Regression 3 in Table 8 indicates that during this thirty-year period, the North-East, the Center, the South and the Islands grew 10%, 9%, 6% and 7% more than the North-West respectively.

How to explain this fact? Jacobs (1969) argues that cities need to costantly reinvent themselves. Specialization in one area may yield brief success but eventually the area decreases, or the area's comparative advantage decays, and reinvention is necessary. Similarly, Glaeser et al. (1995) suggest that cities followed the fortunes of the industries they are involved. The typical industry's growth follows an S-shaped pattern: rapid growth, followed by slower growth and then decline. In particular, the reinvention-city hypothesis states that schooling predicts city growth because human capital enables people to adapt well to structural changes and then cities survive only by adapting their economies to new technologies (Glaeser, 2005). This means that skills should only matter among those cities that have received negative shocks.

One way to check the validity of the reinvention hypothesis for the North-West is to see whether skilled places shifted out of manufacturing more quicky. Then, if we will find that cities with high levels of education and significant manufacturing, suppose, in 1951 switched from manufacturing to other industries faster than high-manufacturing areas with less human capital then we will conclude that reinvention holds. Table 16, Panel (A), shows empirically what we have just explained above: in the period 1951-2001, the growth in the share of workers in manufacturing declined in those areas that began with high levels of education and significant manufacturing. The Industrial Triangle and, more generally, the North-West were surely areas with these characteristics. Panel (A) also shows that the employment growth is lower in those areas that started with higher level of employment and skills, although the coefficient on the interaction term is not statistically different from zero.

An alternative strategy to test the reinvention hypothesis is to look at the internal migration. The internal migration has played a crucial role in the history of Italy. Italian migration flows from the backward regions of South to the North were large and persistent during the 1950s and 1960s, but they subsequently declined. In the aftermath of WWII, Southerners and people from the, at that time,

underdeveloped North-East were mainly directed towards the Industrial Triangle. In that decades, huge masses of workers and their families moved on to the North-West in search of the best work opportunities and fostering the urbanization process. Between 1958 and 1963, in Milan moved about 30 percent of southern migrants. In Genoa, population increased by 15 percent in the 1950s. In the period 1960-1963, Turin hosted about 300,000 immigrants from the rest of Italy (Castronovo, 1977).

The South-North (West) migration decreased progressively from the 70's, particularly after the crisis of 1973. Between 1975 and 1983 the net migration flow in the North-West was negative, in contrast population increased in the South because of returnees and new residents. In the period 1984-2000, mainly after 1994, migration flows from the South and the Islands resumed. These new waves of migrants moved towards the North-East and the Center attracted by the industrial districts, the service sector and by the public administration sector in Rome (Basile and Causi, 2007; Piras, 2007).[32] Overall, the dinamics of internal migration suggests that, in the period 1970-2000, immigration was one the most important determinant of population and employment growth, particularly in those cities and LLMs outside the North-West allowing, in this way, convergence across Italian cities as shown by stylized facts #3 and #5.

If we interpret immigration as a positive shock and take into account that reivention hypothesis requires that human capital should only matter among those areas that have received negative shocks, then we expect education does not matter much in immigrant cities. In other words, adaptation is not necessary in those areas with positive exogenous shocks, which in turn supports the reivention hypothesis.

Table 14, Panel (B) presents the results of this exercise. We collect data on the number of immigrants from the *Popolazione e Movimento Anagrafico dei Comuni* published by the ISTAT for the years 1971, 1981, 1991 and 2001. Employment growth regression suggests that the impact of human capital on employment is reduced in those cities that begin tha decade with a large share of immigrants (interaction between education and the share of immigrants).

6. Skills and Preferences: testing the gentrification hypothesis

The empirical fact #7 shows that education predicts employment growth but population decline in our sample of cities in the period 1971-2001. Although such as evidence might seem puzzling, it is compatible with our findings according to which cities with more educated population experience more rapid growth in the quality of life. Gentrification is a shift in an urban community toward wealthier residents and/or businesses and increasing property values. Gentrification is typically the result of investment in a community by local government, community activists, or business groups, and can often spur economic development, attract business, lower crime rates, and have other benefits to a community. In addition to these potential benefits, it has been suggested that urban gentrification can lead to population migration, which may involve poorer and less skilled residents being displaced by wealthier and more educated newcomers.

According to Ley (1978, 1980), in contemporary post-industrial cities, where white-collar service occupations supersede blue-collar productive occupations, emphasis is on consumption and amenity, not work. Patterns of consumption come to dictate patterns of production: "*the values of consumption rather than production guide central city land use decisions* ". Gentrification is explained as a

[32] For further details on the internal migration literature in Italy see also Brunello, Lupi and Ordine (2001), Faini *et al.* (1997), Attanasio and Padoa-Schioppa (1991) and Cannari, Nucci and Sestito (2000).

consequence of this new emphasis on consumption. It represents a new urban geography for a new social regime of consumption.

In order to test gentrification hypothesis we need to modify the model used in section 3 and introduce a preference bias towards quality of life. Assume, then, that highly-educated people have stronger preferences for urban amenities than less-educated.[33] Given this assumption, the more educated will be ready to accept some wage discount and pay high rents to live in more amenable cities; that is they are willing to accept a (relative) lower real wage. In contrast, since the less educated are relatively less keen to live in that places, high rents must be compensated by higher wage otherwise a process of gentrification activates and as a consequence they will be found in less pleasant cities or in the suburbs.

Suppose that there are two types of individuals, high skill and low skill, who receive different wages in the city *i* denoted by $W_{i,L}$and $W_{i,H}$ respectively. Let be the utility of a low-skilled individual who lives in cities *i* given by:

$$U_{i,L} = \left(Q_i^{\rho}\right) Y_{i,L}^{\mu} (L^c)_{i,L}^{1-\mu} \tag{14}$$

where $\rho > 0$. The utility of a highly-educated individual living in the city *i* will be:

$$U_{i,H} = \left(Q_i^{\rho}\right)(Q_i^{\tau}) Y_{i,H}^{\mu} (L^c)_{i,H}^{1-\mu} \tag{15}$$

where the shifter term (Q_i^{τ}) formalizes our assumtion according to which quality of life can have a differential effect on the utility of a skilled agent and then $\tau \geq 0$ must hold. The spatial equilibrium hypothesis requires that both types of workers must be indifferent across space. Thus, maximization of utilities (14) and (15) together with free-mobility imply that the reservation utility for low-skilled workers and high-skilled workers have the following form:

$$\frac{\gamma Q_i^{\rho} W_{i,L}}{P_i^{1-\mu}} = \overline{U}_L \tag{16}$$

$$\frac{\gamma Q_i^{(\rho+\tau)} W_{i,H}}{P_i^{1-\mu}} = \overline{U}_H \tag{17}$$

where $\gamma \equiv \mu^{\mu}(1-\mu)^{1-\mu}$. Taking logs and differentiating, the spatial equilibrium conditions (16) and (17) imply that:

$$\begin{aligned} dlog\, W_{i,L} &= I^L - \rho\, dlogQ_i + (1-\mu)\, dlogP_i + \eta_{i,L} \\ dlog\, W_{i,H} &= I^H - (\rho+\tau)\, dlogQ_i + (1-\mu)\, dlogP_i + \eta_{i,H} \end{aligned} \tag{18}$$

[33] A similar approach is used in Dalmazzo and de Blasio (2011), Glaeser et *al.* (2001) and Carlino and Saiz (2008).

where I^L and I^H are specific intercepts in the wage regressions for unskilled and skilled individuals respectively. Given prices in the area i , equations (18) tell us that, when $\tau > 0$, gentrification hypothesis holds if two conditions are satisfied. First, the effect of the quality of life on the skilled wages must be negatively stronger than the impact on unskilles wages; that is $\frac{dlog\, W_{i,H}}{dlogQ_i} < \frac{dlog\, W_{i,L}}{dlogQ_i}$. In other words, if we accept the results in section 4 according to which cities with more educated population experience more rapid growth in the quality of life, then high quality of life is expected to produce larger wage increases among the less educated.[34] Second, these larger wage increases which low-skilled individuals receive should be low enough so as not to compensate the higher prices in more amenable cities. If so, less educated persons move towards suburbs and the gentrification process activates.

In order to estimate equations (18), once again we exploit the SHIW. In the 1993 wave, interviewed were asked to provide their own evaluation about several quality of life indicators which are reported in Table 17. Specifically, the household head was required, taking into account also her family members' experience, to give a score from 1 (lowest satisfaction) to 10 (highest satisfaction) on some direct measures of quality of life in the municipality of residence. Yet, since it is very difficult to identify the urban attributes that rise most in their valuation by individuals, we also use the 1995 wave, where interviewed were asked to provide a judgment on their job satisfaction ranging from 1 (lowest) to 5 (highest). Specifically, employed individuals were required to assess the overall satisfaction and other aspects of their job which are reported in Table 18.[35]

Table 17 and Table 18 show the impact of the cities' attributes and job satisfaction on the wage respectively. For each quality-of-life measure we regress the log of the wage on that measure and an interaction term between the latter and human capital variables. If skilled individuals (college graduated and postgraduated) evaluate more the quality of life and as a consequence are willing to accept some wage discount to live in better cities or be occupied in better workplaces these interaction terms should be able to capture most of its essence. Our findings point out mixed results. First of all, as predicted by the theory and shown by the first row of Table 17, the impact of quality of life on the wage is negative. This is particularly true for attributes such as public transportation (column 1), local bureaucracy (column 3), traffic congestion (column 4), quality of schools (column 7), street cleaning (column 8), crime control (column 10), shopping possibilities (11) and leisure activities (column 12). Second, it seems that the more educated (post-graduated) are willing to accept wage cuts to avoid crime and traffic congestion and to live in places with a good public transportation network, good health services, an efficient bureaucracy and with cultural amenities such as theatres and museums. The interaction term on air quality and the availability of green areas also enter significantly. However, as shown by

[34] Note that once multiple skill levels are introduced, the Cobb-Douglas production function implies that, in a world of perfect mobility, differences in productivity across areas depend exclusively on the different quantities of skilled people , not on different returns to skilled people across space. This means that when $\tau = 0$, then there should be no heterogeneity in the skill premium across space. In contrast, when $\tau > 0$, as in the case here, then there will be heterogeneity in the skill premium across areas, but that heterogeneity will be driven by differences in the amenity shifter in the utility of individuals, not by differences in city-specific factors which impact the productivity of highly educated people. Therefore, under Cobb-Douglas technology and if we accept the idea that the more educated will be ready to accept some wage discount and pay high rents to live in more amenable cities, this model of consumer welfare predicts that places with lower skill premia are not places where skilled people are less productive, but rather places where the quality of life is higher since wages are negatively associated with consumption amenities (Glaeser, 2008 pag. 85-86).

[35] The 1993 and 1995 special data were first used by Dalmazzo and de Blasio (2011).

Table 17, our results hold only at the top of education distribution and not also for the college graduated.
In contrast, individuals with an university degree seem to be particularly sensitive to the quality of their job. Table 18 shows that skilled workers are willing to substitute their wage for better enviromental conditions (column 2), for a more interesting job (column 5) and for jobs that enjoy a good reputation (column 6). Note that all individuals are willing to accept a lower salary to avoid risks to life and health and to reduce the probability of being unemployed. Finally, the positive but not significant coefficients on the high school education may suggest that less skilled individuals are not compensated enough to pay the higher housing prices to live in more pleasant places.

The major caveat of this exercise is the lack of suitable data. Testing the gentrification hypothesis would require data at the neighborhood-level within the city rather than aggregate data at the city-level. However our interpretation is that these results represent a very preliminary evidence that a process of gentrification may have occurred. We believe that disaggregated data and additional research is required to better clarify this point.

7. Conclusions

Our research has examined the role of human capital in shaping the urban structure in Italy. The concentration of graduates is positively related to the employment growth in the local labour markets and cities. At the mean and all else equal, the employment growth is about 0.8 percent greater in a LLM that starts the decade with a 10 percent more of college-educated with respect to another LLM. We distinguished between two channels of local development, production-led growth and quality of life-led growth. Human capital -or education- operates mainly by increasing local productivity; however consumption externalities play an important role in driving the success of cities. From a public policy standpoint, as human beings are increasingly keen towards physical environment and as the demand for living in cities goes beyond urban wage, it seems that local administrators should foster quality of life of their economies. Consumption opportunities and a better working environment will become more and more critical in determining the attractiveness of urban areas.

Our results inform other two findings. First, we find that human capital help cities to absorb adverse shocks and reinvent themselves. The case of the North-West is striking. The growth in the share of workers in manufacturing declined in those areas that began with high levels of education and significant manufacturing.

Second, we also indicate that a process of gentrification may have been activated in Italy in the period 1971-2001. Introducing preferences heterogeneity towards quality of life, we assume that highly-educated people have stronger preferences for urban amenities than less-educated. As a consequence the more educated will be ready to accept some wage discount and pay high rents to live in more pleasant cities. In contrast, since the less educated have weaker preferences to live in that places, high rents must be compensated by higher wage otherwise a process of gentrification activates. This paper argues that public transportation, local bureaucracy, traffic congestion, quality of schools, street cleaning, crime control and leisure activities are particularly critical urban amenities. Interesting jobs and jobs that enjoy a good reputation also appear to important in attracting a highly educated workforce.

Although some points need further discussion, we hope our research draws more attention and interest in investigate the role of urban areas on our well-being since our life hinges more and more on the knowledge of how they work and how they should be managed.

References

Adamson, Dwight W., David E. Clark and Mark D. Partridge. 2004. Do urban agglomeration effects and households amenities have a skill bias? *Journal of Regional Science* 44(2): 201-223.

Albanese, Giuseppe and Guido de Blasio. 2014. Civic Capital and Development in Italy, 1951-2001. Bank of Italy Economic History Working Papers 32, Bank of Italy, Rome.

Attanasio, Orazio and Fiorella Padoa-Schioppa. 1991. Regional Inequalities, Migration and Mismatch in Italy, 1960-1986. In Fiorella Padoa-Schioppa (eds.), *Mismatch and Labour Mobility*, Cambridge: Cambridge University Press, 238-321.

Basile, Roberto and Marco Causi. 2007. Le determinanti dei flussi migratori nelle province italiane: 1991-2001. *Economia & Lavoro* 2: 139-159.

Bosker, E. Marteen, Steven Brakman, Harry Garretsen, Herman de Jong and Marc Schramm. 2008. The Development of Italian Cities 1300-1861. *European Review of Economic History* 12: 97-131.

Brunello, Giorgio, Claudio Lupi and Patrizia Ordine. 2001. Widening Differences in Italian Regional Unemployment. *Labour Economics* 8: 103-129.

Castronovo, Valerio. 1977. Il Piemonte. In Giulio Einaudi (eds.) *Storia d'Italia. Le Regioni dall'Unita' ad oggi*, volume 1. Torino.

Cannari, Luigi, Francesco Nucci and Paolo Sestito. 2000. Geographic labour mobility and the cost of housing: evidence from Italy. *Applied Economics* 32(14): 1899-1906.

Carlino, Gerald A. and Albert Saiz. 2008. City beautiful. Working Paper 08-22, Federal Reserve Bank of Philadelphia.

Cerrito, Elio. 2010. La politica dei poli di sviluppo nel Mezzogiono. Elementi per una prospettiva storica. Bank of Italy Economic History Working Papers 3, Bank of Italy, Rome.

Croce, Giuseppe and Lucio Morettini. 2011. La convergenza dei livelli di capitale umano tra le province italiane dal 1971 al 2001. In Donatella Strangio (ed.) *Internazionalizzazione e delocalizzazione delle imprese*, McGraw-Hill, Milano, 73-90.

Dalmazzo, Alberto and Guido de Blasio. 2007. Production and consumption externalities of human capital: An empirical study for Italy. Journal of Population Economics 20: 359-382.

Dalmazzo, Alberto and Guido de Blasio. 2011. Amenities and skill-biased agglomeration effects: Some results on Italian cities. *Papers in Regional Science* 90: 503-527.

Di Addario, Sabrina and Eleonora Patacchini. 2008. Wages and the city. *Labour Economics* 15(5): 1040-1061.

Duranton, Gilles and Diego Puga. 2004. Micro-foundantions of urban agglomeration economies. In Vernon Henderson and Jacques-François Thisse (eds.) *Handbook of Regional and Urban Economics*, volume 4. Amsterdam: North-Holland, 2063-2117.

Duranton, Gilles and Diego Puga. 2013. The Growth of Cities. CEPR Discussion Papers 9590, Centre for Economic Policy Research, London.

Eaton, Jonathan and Zvi Eckstein. 1997. Cities and Growth: Theory and evidence from France and Japan. *Regional Science and Urban Economics* 27(4-5): 443-474.

Faini, Riccardo, Giampaolo Galli, Pietro Gennari and Fulvio Rossi. 1997. An empirical puzzle: Falling migration and growing unemployment differentials among Italian regions. *European Economic Review Papers and Proceedings* 41(3-5): 571-579.

Felice, Emanuele. 2011a. The determinants of italy's regional imbalances over the long run: Exploring the contributions of human and social capital. Oxford University Discussion Papers in Economic and Social History 88, Oxford University, Oxford.

Gabaix, Xavier. 1999b. Zipf's law and the growth of cities. *American Economic Review Papers and Proceedings* 89(2): 129-132.

Gabaix, Xavier and Yannis M. Ioannides. 2004. The evolution of city size distributions. In Vernon Henderson and Jacques-François Thisse (eds.) *Handbook of Regional and Urban Economics*, volume 4. Amsterdam: North-Holland, 2341-2378.

Gabriel, Stuart A., and Stuart S. Rosenthal. 2004. Quality of the Business Environment Versus Quality of Life: Do Firms and Households Like the Same Cities? *The Review of Economics and Statistics* 86(1): 438-444.

Glaeser, Edward L. 1994. Cities, information, and economic growth. *Cityscape* 1(1): 9–47.

Glaeser, Edward L. 2005. Reinventing Boston, 1630-2003. *Journal of Economic Geography* 5: 119-153.

Glaeser, Edward L. 2008. *Cities, agglomeration and spatial equilibrium*. Oxford: Oxford University Press, New York

Glaeser, Edward L. and Joseph Gyourko. 2005. Urban decline and durable housing. *Journal of Political Economy* 113(2): 345-375.

Glaeser, Edward L. and Albert Saiz. 2004. The rise of the skilled city. *Brookings-Wharton Papers on Urban Affairs*, 5: 47-95.

Glaeser, Edward L., and Jesse M. Shapiro. 2003. Urban Growth in the 1990s: Is City Living Back? *Journal of Regional Science* 43(1) 139-165.

Glaeser, Edward, L., and Joshua D. Gottlieb. 2006. Urban Resurgence and the Consumer City. HIER Discussion Papers 2109, Harvard Institute of Economic Reseach, Harvard University, Cambridge, Mass.

Glaeser, Edward L., and Matthew G. Ressenger. 2010. The Complementarity between Cities and Skills. *Journal of Regional Science* 50(1): 221-244.

Glaeser, Edward L., Josè A. Scheinkman, and Andrei Shleifer. 1995. Economic-growth in a cross-section of cities. *Journal of Monetary Economics* 36(1): 117-143.

Glaeser, Edward L., Jed Kolko, and Albert Saiz. 2001. Consumer City. *Journal of Economic Geography* 1(1): 27-50.

Glaeser, Edward L., Giacomo A. M. Ponzetto, and Kristina Tobio. 2011. Cities, skills, and regional change. HIER Discussion Papers 2191, Harvard Institute of Economic Reseach, Harvard University, Cambridge, Mass.

Jacobs, Jane. 1969. *The Economy of Cities*. New York: Random House.

Krugman, Paul. 1991. *Geography and Trade*. Cambridge: MIT press.

Ley, David. 1978. Inner city resurgence and its social context. Paper presented at the annual conference of the Association of American Geographers, New Orleans.

Ley, David. 1980. Liberal ideology and the postindustrial city. *Annals of the Association of American Geographers* 70: 238–258.

Malanima, Paolo. 1998. Italian Cities 1300-1861. A quantitative approach. *Rivista di Storia Economica* 14(2): 91-126.

Marshall, Alfred. 1890. *Principles of Economics*. London: Macmillan.

Moretti, Enrico. 2004a. Estimating the social return to higher education: Evidence from longitudinal and repeated cross-sectional data. *Journal of Econometrics* 121(1): 175-212.

Moretti, Enrico. 2013. *La nuova geografia del lavoro*. Edizioni Mondadori.

Percoco, Marco. 2013. Geography, institutions and urban development: Italian cities, 1300–1861. *The Annals of Regional Science* 50(1): 135-152.

Piras, Romano. 2007. Rendimento del capital umano, qualità dell'istruzione e fuga dei cervelli dal Mezzogiorno. *Economia & Lavoro*. 2: 119-138.

Porter, Michael E. 1990. *The Competitive Advantage of Nations*. New York: Free Press.

Putnam, Robert D. 1993. *Making Democracy Work. Civic Traditions in Modern Italy*. Princeton: Princeton University Press.

Raitano, Michele. 2014. L'impatto delle spese per l'abitazione di residenza sulla distribuzione dei redditi familiari in Italia. Paper presented at the Law and Economics dept., Sapienza University of Rome, Rome.

Rosenthal, Stuart S., and William Strange. 2004. Evidence on the nature and sources of agglomeration economies. In Vernon Henderson and Jacques-François Thisse (eds.) *Handbook of Regional and Urban Economics*, volume 4. Amsterdam: North-Holland, 2119-2171.

Rossi-Hansberg, Esteban and Mark L.J. Wright. 2007. Urban structure and growth. *Review of Economic Studies* 74(2): 597-624.

Shapiro, Jesse M. 2006. Smart cities: Quality of life, productivity, and the growth effects of human capital. *review of Economics and Statistics* 88: 324-335.

Simon, Curtis J., and Clark Nardinelli. 2002. Human capital and the rise of American cities: 1900-1990. *Regional Science and Urban Economics* 32(1): 59-96.

Stock, James H., and Motohiro Yogo. 2005. Testing for weak instrument in linear IV regression. In Andrews DWK (eds) *Identification and Inference for Econometric Models*. Cambrige: Cambrige University Press, UK, 80-108.

Growth in Italian Cities

Figures and Tables.

Figure 1.

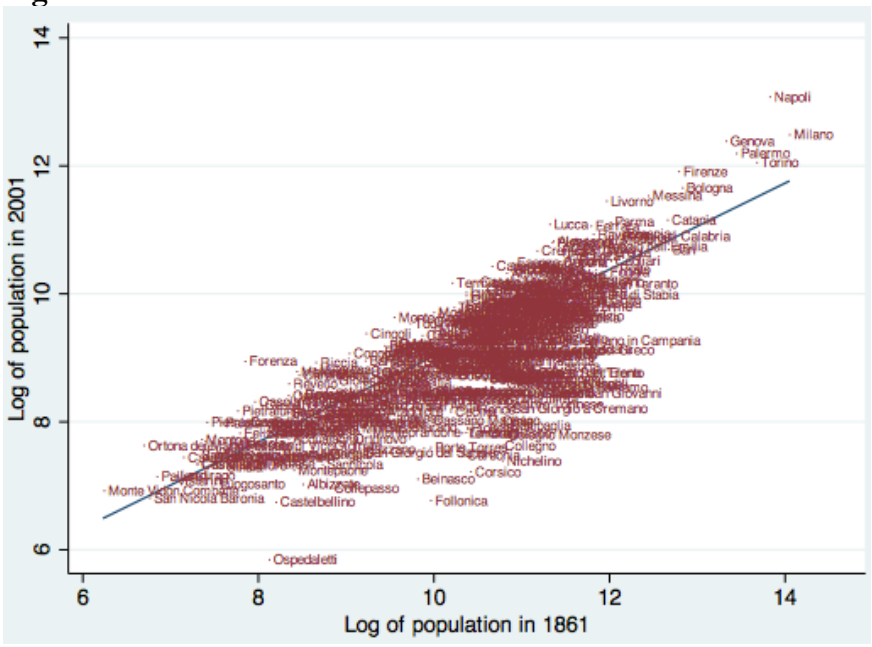


Figure shows 369 cities out of 442 (our entire sample) which belonged to the Kingdom of Italy in 1861. Therefore are excluded those cities that belonged to the Papal State and the region of 'Triveneto'; the latter at the time under the control of the Austrian Empire. Sources: Population Censuses 1861-2001, ISTAT.

Table 1.
Population Growth Correlations.

Decades	(1) Correlation with lagged population change	(2) Correlation with lagged population change (50,000+)	(3) Correlation with initial log population	(4) Correlation with initial log pop (50,000+)
1861-1871			-0.0151	0.0512
1871-1881	0.0830	0.1823 (18)	-0.0281	0.4127
1881-1901	0.3690	0.8396 (25)	0.0308	0.5463
1901-1911	0.3539	0.5971 (28)	0.0252	0.2582
1911-1921	0.0632	-0.5831 (37)	0.1893	0.2827
1921-1931	0.1464	0.2278 (46)	-0.0520	0.2235
1931-1951	0.2808	0.2820 (60)	0.0306	0.2772
1951-1961	0.3713	0.4772 (61)	0.1971	-0.0497
1961-1971	0.6404	0.1787 (82)	0.2899	-0.0946
1971-1981	0.2499	-0.0061 (95)	-0.0053	-0.1780
1981-1991	-0.3528	-0.8624 (110)	-0.0994	-0.4469
1991-2001	0.2590	0.6053 (128)	-0.0893	-0.1546

The Population Censuses in 1891 and in 1941 were not carried out because of financial difficulties in the first case and WWII in the second one. Numbers in brackets denote the number of observations, that is those cities that had al least 50,000 inhabitants at the start of the lagged decade. Sources: Population Censuses 1861-2001, ISTAT.

Figure 2.

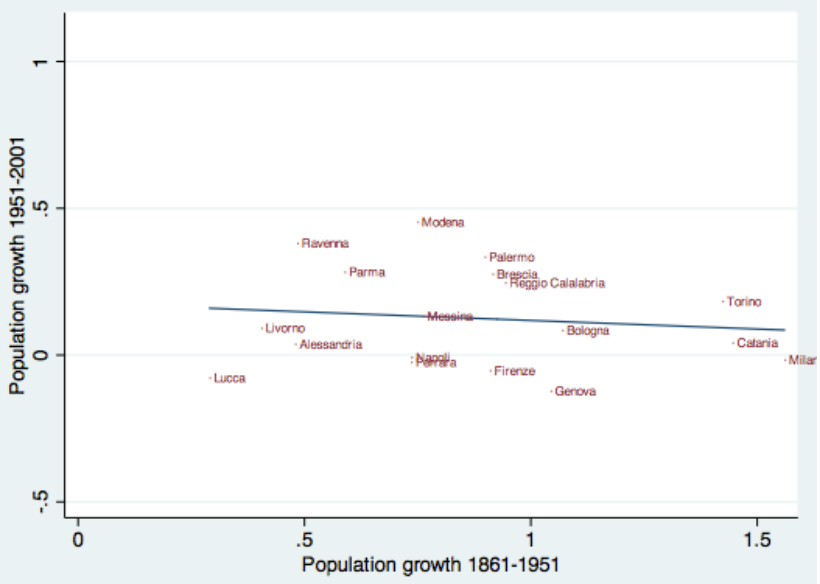


Figure shows the slightly negative correlation of population growth for those cities with more than 50,000 inhabitants in 1861. The number of observations is 18. Sources: Population Censuses 1861-2001, ISTAT.

Figure 3.

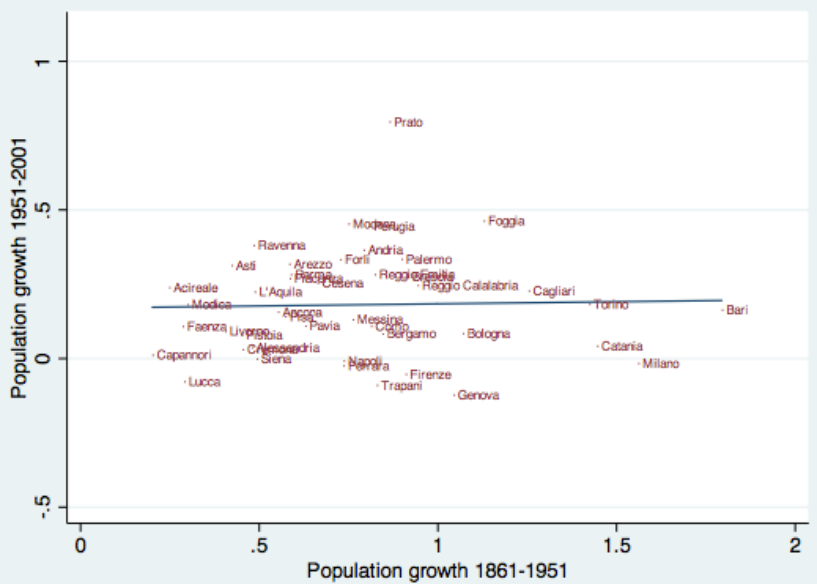


Figure shows the correlation of population growth for those cities with more than 30,000 inhabitants in 1861. The number of observations is 44. Sources: Population Censuses 1861-2001, ISTAT.

Table 2.
Population Growth and Geography.

Decades	(1) Correlation with Initial log population in the North-West	(2) Correlation with proximity to Industrial Triangle
1861-1871	0.0608	0.0511
1871-1881	0.0792	0.1564
1881-1901	0.0851	0.1918
1901-1911	0.0561	0.2853
1911-1921	0.0212	0.1631
1921-1931	0.0502	0.2303
1931-1951	-0.0554	0.2939
1951-1961	0.1086	0.4342
1961-1971	0.1761	0.2371
1971-1981	-0.2223	0.0106
1981-1991	-0.4296	-0.1372
1991-2001	-0.4090	-0.0250

Sources: Population Censuses 1861-2001, ISTAT.

Figure 4.

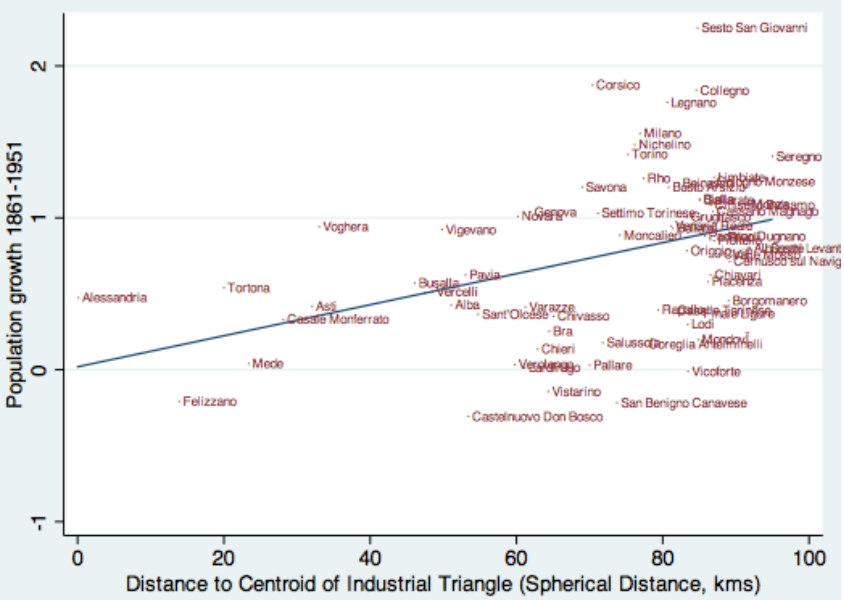


Figure shows the cities that are within 100 kilometers of the Industrial Triangle centroid. Sources: Population Censuses 1861-2001, ISTAT. Georeferenced data are from ISTAT. We use the software R for the calculations.

Table 3.
Growth Population Regressions and Geography.

A.	Population growth					
	(1)	(2)	(3)	(4)	(5)	(6)
	1861-1881	1881-1901	1901-1921	1921-1951	1951-1971	1971-2001
Ind. Tria.	0.0004	0.002	0.003	0.006	0.008	0.001
	(0.0005)	(0.0006)**	(0.0007)***	(0.0013)***	(0.002)***	(0.0006)*
Log pop 1861	0.021					
	(0.011)*					
Log pop 1881		0.046				
		(0.010)***				
Log pop 1901			0.040			
			(0.014)***			
Log pop 1921				0.011		
				(0.022)		
Log pop 1951					0.010	
					(0.035)	
Log pop 1971						-0.050
						(0.013)***
Obs	69	70	70	70	70	70
R-squared	0.057	0.125	0.170	0.198	0.103	0.268
B.						
Log pop 1861	0.002					
	(0.006)					
Log pop 1881		0.004				
		(0.007)				
Log pop 1901			0.016			
			(0.006)**			
Log pop 1921				-0.006		
				(0.018)		
Log pop 1951					0.074	
					(0.014)***	
Log pop 1971						-0.019
						(0.009)**
Constant	0.128	0.107	0.037	0.336	-0.285	0.185
	(0.053)**	(0.069)	(0.070)	(0.177)*	(0.160)*	(0.095)*
North-East	-0.067	-0.038	0.024	-0.093	-0.322	0.053
	(0.017)***	(0.019)**	(0.022)	(0.034)***	(0.054)***	(0.028)*
Center	-0.014	0.027	-0.026	0.004	-0.285	0.103
	(0.018)	(0.022)	(0.022)	(0.051)	(0.061)***	(0.027)***
South	0.018	0.011	-0.044	0.063	-0.327	0.148
	(0.020)	(0.021)	(0.021)**	(0.040)	(0.056)***	(0.030)***
Islands	0.065	0.061	-0.004	-0.053	-0.326	0.124
	(0.025)**	(0.024)**	(0.028)	(0.061)	(0.057)***	(0.034)***
Obs	369	425	425	442	422	442
R-squared	0.060	0.043	0.045	0.028	0.160	0.072

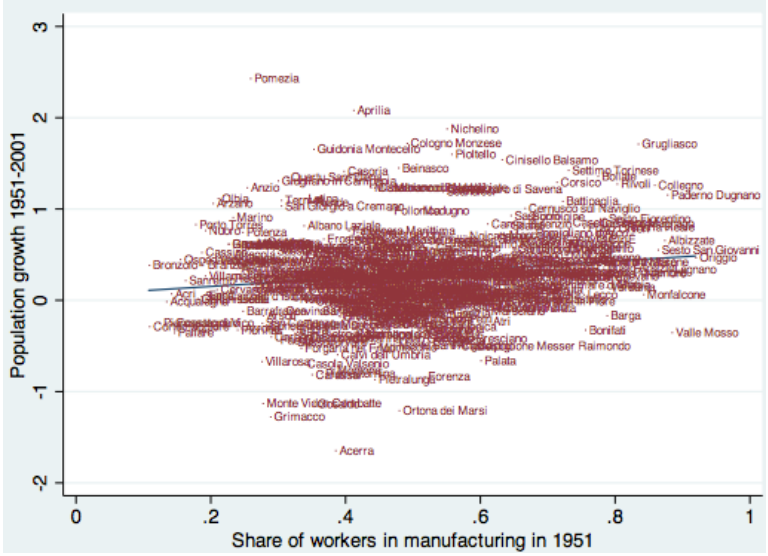
Numbers in parentheses denote robust standard errors. ***, **, * denote significance at the 1%, 5%, 10% level respectively. Sources: Population Censuses 1861-2001, ISTAT. Georeferenced data are from ISTAT.

Table 4.
Growth Employment Regressions and Geography.

A.	Employment growth			
	(1)	(2)	(3)	(4)
	1911-1927	1927-1951	1951-1971	1971-2001
Ind. Tria.	0.001	0.001	0.006	0.002
	(0.0005)**	(0.0018)	(0.003)**	(0.0005)***
Log emp 1911	-0.070			
	(0.063)			
Log emp 1927		0.035		
		(0.022)		
Log emp 1951			-0.124	
			(0.056)**	
Log emp 1971				-0.038
				(0.012)***
Obs	28	28	70	70
R-squared	0.051	0.057	0.115	0.233
B.				
Log emp 1911	-0.170			
	(0.050)***			
Log emp 1927		-0.050		
		(0.023)**		
Log emp 1951			-0.025	
			(0.017)	
Log emp 1971				-0.031
				(0.013)**
Constant	2.422	0.720	0.820	0.633
	(0.463)***	(0.229)***	(0.178)***	(0.122)***
Nort-East	-0.065	0.004	-0.014	0.256
	(0.094)	(0.066)	(0.088)	(0.044)***
Center	-0.156	-0.110	0.055	0.330
	(0.101)	(0.066)*	(0.091)	(0.040)***
South	-0.078	-0.042	-0.110	0.475
	(0.134)	(0.064)	(0.088)	(0.045)***
Islands	-0.035	-0.095	-0.157	0.445
	(0.174)	(0.070)	(0.097)	(0.056)***
Obs	219	228	442	422
R-squared	0.200	0.056	0.020	0.256

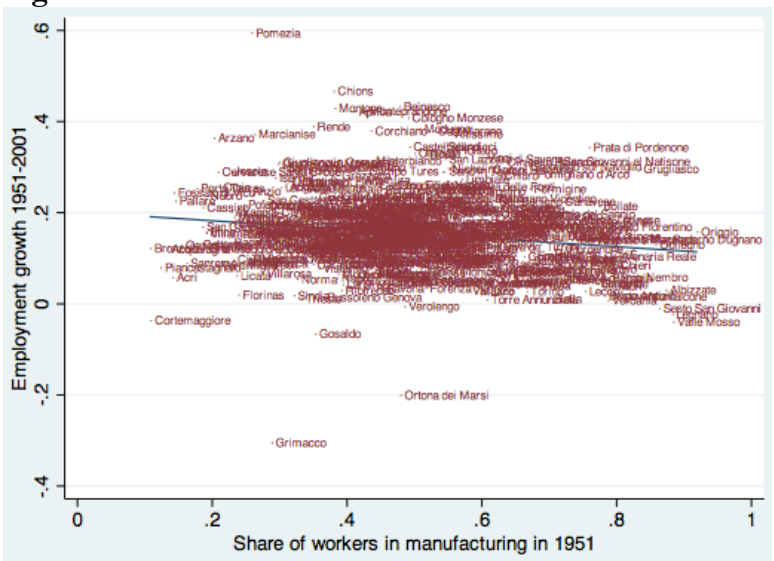
Numbers in parentheses denote robust standard errors. ***, **, * denote significance at the 1%, 5%, 10% level respectively. Sources: Industrial and Commercial Censuses 1911-2001, ISTAT. Georeferenced data are from ISTAT.

Figure 5.1



Sources: Population Censuses 1951-2001 and Industrial and Commercial Censuses 1951-2001, ISTAT.

Figure 5.2



Sources: Population Censuses 1951-2001 and Industrial and Commercial Censuses 1951-2001, ISTAT.

Table 5.
Growth and Manufacturing.

	Cities		LLMs	
	(1)	(2)	(3)	(4)
	Pop growth Correlation With share In manufct	Emp growth Correlation With share In manufct	Pop growth Correlation With share In manufct	Emp growth Correlation With share In manufac
Decades	In 1951	In 1951	In 1971	In 1971
A.				
1951-1961	0.1627	0.0479		
1961-1971	0.4509	0.0141		
1971-1981	0.0393	-0.3109	-0.0178	-0.5112
1981-1991	-0.1000	-0.1421	-0.0742	-0.2955
1991-2001	0.0030	0.0468	0.2862	0.1933

The LLMs' boundaries are those defined by the ISTAT in 1997. Data at LLM level are available from 1971 onward. Sources: Population Censuses 1951-2001 and Industrial and Commercial Censuses 1951-2001, ISTAT.

Table 6.
Growth and Education.

	Cities		LLMs
	(1)	(2)	(3)
	Pop growth Correlation With lagged	Emp growth Correlation With lagged	Pop growth Correlation With lagged
Decades	grads share	grads share	grads share
A.			
1951-1961	0.2330	0.0773	
1961-1971	0.0957	-0.0518	
1971-1981	-0.1801	0.0390	0.0102
1981-1991	0.5950	0.0313	-0.1419
1991-2001	-0.2915	0.1321	-0.0806
B.	(50, 000+)	(50, 000+)	(100,000+)
1951-1961	0.3376 (81)	-0.0930	
1961-1971	0.0574 (94)	0.0822	
1971-1981	-0.2251 (110)	0.1509	-0.2030 (106)
1981-1991	-0.3881 (128)	0.0537	-0.3869 (108)
1991-2001	-0.3045 (135)	-0.1643	-0.1766 (113)

The LLMs' boundaries are those defined by ISTAT in 1997. Data at LLM level are available from 1971 onward. Numbers in brackets denote the number of observations, that is those cities (LLMs) that had al least 50,000 (100,000) inhabitants in the initial year. Sources: Population Censuses 1951-2001 and Industrial and Commercial Censuses 1951-2001, ISTAT.

Table 7.
LLM Growth and Human Capital

Ten-year employment growth: log(employmenti,t/employmenti,t-10)						
	(1)	(2)	(3)	(4)	(5)	(6)
Log (% Share of College Graduates), t-10	**0.087**	**0.067**	**0.064**	**0.026**	**0.124**	
	(0.020)***	(0.020)***	(0.020)***	(0.041)	(0.050)***	
Log (Employment), t-10	-0.066	-0.444	-0.345	-0.814	-0.739	-0.429
	(0.007)***	(0.046)***	(0.045)***	(0.037)***	(0.091)***	(0.044)***
Log (% Share of Workers in Manufacturing), t-10		0.105	0.121	0.042	-0.003	0.105
		(0.019)***	(0.018)***	(0.025)*	(0.044)	(0.019)***
Log (% Share of Workers in Services), t-10		0.041	0.032	0.049	-0.016	0.047
		(0.025)	(0.023)	(0.031)	(0.040)	(0.025)*
Log (% Share of Workers in Trade), t-10		0.076	0.011	-0.019	-0.019	0.070
		(0.037)**	(0.038)	(0.046)	(0.081)	(0.037)*
Log (% Share Manu), t-10*1981 Dummy			-0.141			
			(0.029)***			
Log (% Share Manu), t-10*1991 Dummy			-0.054			
			(0.013)***			
Log (% Share of College Graduates), 1951						**0.039**
						(0.011)***
North-East			0.092			
			(0.013)***			
Center			0.041			
			(0.013)***			
South			-0.013			
			(0.025)			
Islands			-0.038			
			(0.032)			
Lagged Age Distribution	no	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes
Region fixed effects	no	yes	no	no	no	yes
LLM fixed effects	no	no	no	yes	yes	no
Observations	831	831	831	831	340	816
Local Labor Markets	277	277	277	277	120	272
R-squared	0.713	0.826	0.820	0.948	0.962	0.827
Estimation Method	OLS	OLS	OLS	OLS	OLS	OLS

Table shows the impact of the log of the percent college graduates on employment growth, measured as the log change of employment between census waves. Standard errors, reported in parenthesis, have been adjusted for serial correlation within local labor markets. ***, **, * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

Table 8.
City Growth and Human Capital.

	Ten-year employment growth: log(employmenti,t/employmenti,t-10)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log (% Share of College Graduates), t-10	**0.064**	**0.064**	**0.065**	**0.000**	**0.108**			**0.124**
	(0.015)***	(0.019)***	(0.018)***	(0.023)	(0.048)***			(0.042)***
Log (Employment), t-10	-0.047	-0.257	-0.205	-0.874	-0.766	-0.267	-0.308	-0.074
	(0.007)***	(0.041)***	(0.037)***	(0.058)***	(0.085)***	(0.040)***	(0.045)***	(0.012)***
Log (% Share of Workers in Manufacturing), t-10		0.072	0.099	0.021	-0.001	0.084	0.042	0.074
		(0.022)***	(0.023)***	(0.036)	(0.035)	(0.023)***	(0.022)*	(0.020)***
Log (% Share of Workers in Services), t-10		-0.026	-0.028	-0.006	-0.016	-0.021	0.030	0.046
		(0.014)*	(0.014)**	(0.010)	(0.045)	(0.013)	(0.035)	(0.035)
Log (% Share of Workers in Trade), t-10		0.107	0.081	0.011	-0.041	0.114	0.141	0.279
		(0.036)***	(0.034)**	(0.041)	(0.074)	(0.035)***	(0.042)***	(0.033)***
Log (% Share Manu), t-10*1981 Dummy			-0.105					
			(0.025)***					
Log (% Share Manu), t-10*1991 Dummy			-0.068					
			(0.021)***					
Log (% Share of College Graduates), 1951						**0.084**		
						(0.017)***		
Log (% Share of High School Enrollment), 1931							**0.049**	
							(0.012)***	
North-East			0.097					
			(0.017)***					
Center			0.091					
			(0.016)***					
South			0.068					
			(0.031)**					
Islands			0.070					
			(0.032)**					
Lagged Age Distribution	no	yes	yes	yes	yes	yes	yes	no
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Region fixed effects	no	yes	no	no	no	yes	yes	yes
LLM fixed effects	no	no	no	yes	yes	no	no	no
Observations	1326	1326	1326	1326	399	1303	483	483
Cities	442	442	442	442	145	438	161	161
R-squared	0.546	0.648	0.657	0.878	0.936	0.654	0.848	0.841
Estimation Method	OLS	OLS	OLS	OLS	OLS	OLS	OLS	IV

Table shows the impact of the log of the percent college graduates on employment growth, measured as the log change of employment between census waves. Standard errors, reported in parenthesis, have been adjusted for serial correlation within local labor markets. ***, **, * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

Table 9.
Heterogeneity in Human Capital and LLMs Growth

Ten-year employment growth: log(employment,t/employmenti,t-10)	(1)	(2)	(3)	(4)
Log (% Share of College Graduates), t-10	**0.131**	**0.120**	**0.191**	**0.136**
	(0.023)* **	**(0.024)*** **	**(0.024)*** **	**(0.024)*** **
Log (Employment), t-10	-0.065	-0.445	-0.026	-0.420
	(0.007)***	(0.047)***	(0.007)***	(0.048)***
Log (% Share of Workers in Manufacturing), t-10		0.112		0.087
		(0.019)***		(0.020)***
Log (% Share of Workers in Services), t-10		0.031		0.043
		(0.024)		(0.024)*
Log (% Share of Workers in Trade), t-10		0.093		0.033
		(0.037)***		(0.038)
Log (% Share of College Graduates), t-10*1981 Dummy	-0.070	-0.088		
	(0.028)**	(0.020)***		
Log (% Share of College Graduates), t-10*1991 Dummy	-0.047	-0.059		
	(0.022)**	(0.020)***		
Log (% Share of College Graduates), t-10*South Dummy			-0.216	-0.084
			(0.025)***	(0.025)***
Lagged Age Distribution	no	yes	no	yes
Year fixed effects	yes	yes	yes	yes
Region fixed effects	no	yes	no	yes
LLM fixed effects	no	no	no	no
Observations	831	831	831	831
LLMs	277	277	277	277
R-squared	0.716	0.829	0.773	0.828
Estimation model	OLS	OLS	OLS	OLS

Table shows the time-variant (col. 1 and 2) and space-variant (col. 3 and 4) impact of the log of the percent college graduates on employment growth at the LLM level. Standard errors, reported in parenthesis, have been adjusted for serial correlation within cities. ***, ** , * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

Table 10.
Heterogeneity in Human Capital and City Growth

Ten-year employment growth: log(employment,t/employmenti,t-10)	(1)	(2)	(3)	(4)
Log (% Share of College Graduates), t-10	0.118	0.145	0.081	0.085
	(0.020)***	(0.024)***	(0.016)***	(0.019)***
Log (Employment), t-10	-0.048	-0.258	-0.036	-0.257
	(0.007)***	(0.038)***	(0.007)***	(0.040)***
Log (% Share of Workers in Manufacturing), t-10		0.098		0.061
		(0.022)***		(0.023)***
Log (% Share of Workers in Services), t-10		-0.007		-0.029
		(0.013)		(0.014)**
Log (% Share of Workers in Trade), t-10		0.130		0.093
		(0.033)***		(0.036)**
Log (% Share of College Graduates), t-10*1981 Dummy	-0.067	-0.128		
	(0.022)***	(0.019)***		
Log (% Share of College Graduates), t-10*1991 Dummy	-0.081	-0.090		
	(0.022)***	(0.017)***		
Log (% Share of College Graduates), t-10* South Dummy			-0.096	-0.053
			(0.018)***	(0.020)***
Lagged Age Distribution	no	yes	no	yes
Year fixed effects	yes	yes	yes	yes
Region fixed effects	no	yes	no	yes
LLM fixed effects	no	no	no	no
Observations	1326	1326	1326	1311
LLMs	442	442	442	441
R-squared	0.552	0.658	0.566	0.650
Estimation model	OLS	OLS	OLS	OLS

Table shows the time-variant (col. 1 and 2) and space-variant (col. 3 and 4) impact of the log of the percent college graduates on employment growth at the city level. Standard errors, reported in parenthesis, have been adjusted for serial correlation within cities. ***, **, * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

Table 11.
Highest and lowest house price, rental price and wage fixed effects, 1986, 1991 and 2000. City-level.

A. House value fixed effects

	1986		1991		2000	
Highest	Rapallo, GE	(0.45)	Siena, SI	(0.97)	Parcines, BZ	(0.51)
	Siena, SI	(0.34)	Sestri L., GE	(0.47)	Siena, SI	(0.38)
	Roma, RM	(0.32)	Firenze, FI	(0.45)	Bolzano, BZ	(0.29)
	Firenze, FI	(0.31)	Roma, RM	(0.41)	Merano, BZ	(0.29)
	Tivoli, RM	(0.30)	Bolzano, BZ	(0.37)	Bressanone, BZ	(0.23)
Lowest	S. Giovanni F., CS	(-0.71)	Licata, AG	(-0.97)	Cervinara, AV	(-1.24)
	Modica, RG	(-0.75)	Collepasso, LE	(-0.98)	Acri, CS	(-1.25)
	Bolotana, NU	(-0.82)	Palagonia, CT	(-0.99)	S.Giovanni F, CS	(-1.33)
	Villamassargia, CI	(-1.01)	Boscoreale, NA	(-1.00)	Collepasso, LE	(-1.37)
	Castrofilippo, AG	(-1.15)	Barrafranca, EN	(-1.02)	Barrafranca, EN	(-1.45)

B. Rental price fixed effects

	1986		1991		2000	
Highest	Bari, BA	(0.57)	Siena, SI	(0.83)	Albenga, SV	(0.57)
	Cremona, CR	(0.27)	Como, CO	(0.76)	Bolzano, BZ	(0.25)
	Sassari, SS	(0.26)	Livorno, LI	(0.69)	Siena, SI	(0.21)
	Formia, LT	(0.24)	Parma, PR	(0.56)	Monticelli O., PC	(0.18)
	Piacenza, PC	(0.18)	Monteroni d'Arbia, SI	(0.48)	Firenze, FI	(0.15)
Lowest	Castrofilippo, AG	(-1.05)	Palagonia, CT	(-0.74)	Marsala, TP	(-1.27)
	Enemonzo, UD	(-1.05)	Cervinara, AV	(-0.76)	Forenza, PZ	(-1.29)
	Galatina, LE	(-1.06)	S. Giovanni F., CS	(-0.77)	Lizzano, TA	(-1.30)
	Sannicola, LE	(-1.07)	Acri, CS	(-0.82)	S.Giovanni F, CS	(-1.43)
	S. Giovanni F., CS	(-1.14)	Collepasso, LE	(-0.82)	Barrafranca, EN	(-1.51)

C. Hourly wage fixed effects

	1987		1991		2000	
Highest	Ospedaletti, MI	(0.30)	Como, CO	(0.48)	Imperia, IM	(0.12)
	Nembro, BG	(0.24)	Reggello, FI	(0.31)	Piacenza, PC	(0.13)
	Rho, MI	(0.20)	Sassari, SS	(0.25)	Castellano, RE	(0.15)
	Molinella, BO	(0.20)	Carbonia, CI	(0.24)	Padova, PD	(0.16)
	Varese, VA	(0.18)	Sondrio, SO	(0.24)	Riofreddo, RM	(0.22)
Lowest	San Giustino, PG	(-0.32)	Matera, MT	(-0.24)	Pagani, SA	(-0.44)
	Manfredonia, FG	(-0.32)	Alghero, SS	(-0.25)	Scafati, SA	(-0.45)
	Mirandola, MO	(-0.33)	Manfredonia, FG	(-0.26)	Gravina P., BA	(-0.49)
	Trapani, TP	(-0.36)	Lizzano, TA	(-0.28)	Mazzara V., TP	(-0.51)
	Villamassargia, CI	(-0.39)	Terrasini, PA	(-0.30)	Marsala, TP	(-0.69)

House value fixed effects are the coefficients on city dummies in cross-section regressions of the log value of the dwellings on these dummies and controls for observable housing characteristics. Rental price fixed effects are the coefficients on city dummies in cross-section regressions of the log of the annual rent of the dwellings on these dummies and controls for observable housing characteristics. Hourly wage fixed effects are the coefficients on city dummies in cross-section regressions of the log of the hourly wage on these dummies and controls for observable worker features. Sources: see text.

Table 12.
Human capital, House Value and Wage Growth. LLM level

	(1)	(2)	(3)	(4)	(5)
	PANEL A. Dependent variable is growth in House value				
Log (% Share of College Graduates), t-10	**0.141**	**0.134**	**0.055**	**0.154**	
	(0.044)***	(0.039)***	(0.081)	(0.094)*	
Log (House value), t-10	-0.669	-0.895	-1.398	-1.446	-0.911
	(0.075)***	(0.069)***	(0.094)***	(0.082)***	(0.070)
Log (% Share of College Graduates), 1951					**0.084**
					(0.025)***
	PANEL B. Dependent variable is growth in Rental price				
Log (% Share of College Graduates), t-10	**0.330**	**0.359**	**0.515**	**0.824**	
	(0.084)***	(0.075)***	(0.256)**	(0.116)***	
Log (Rental price), t-10	-0.809	-0.956	-1.309	-1.308	-0.969
	(0.063)***	(0.055)***	(0.095)***	(0.107)***	(0.055)
Log (% Share of College Graduates), 1951					**0.222**
					(0.052)***
	PANEL C. Dependent variable is growth in Wage				
Log (% Share of College Graduates), t-10	**0.034**	**0.029**	**-0.255**	**-0.184**	
	(0.020)*	(0.041)	(0.151)*	(0.181)	
Log (Wage), t-10	-0.873	-0.974	-1.539	-1.478	-0.969
	(0.072)***	(0.077)***	(0.089)***	(0.120)***	(0.077)
Log (% Share of College Graduates), 1951					**0.028**
					(0.022)
Year fixed effects	yes	yes	yes	yes	yes
Region fixed effects	no	yes	no	no	yes
LLM fixed effects	no	no	yes	yes	no
Other variables in Table 7	no	yes	yes	yes	yes
Observations	330	330	330	187	330
LLMs	197	197	197	103	197

Table shows the impact of the log of the percent college graduates on the dependent variable in the Local Labour Market. House value, rent and wage growth are measured as the log change in LLM fixed effects obtained as described in section 4.2 in the text. Standard errors, reported in parenthesis, have been adjusted for serial correlation within cities. ***, ** , * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

Table 13.
Human capital, House Value and Wage Growth. City level

	(1)	(2)	(3)	(4)	(5)
	PANEL A. Dependent variable is growth in House value				
Log (% Share of College Graduates), t-10	**0.163**	**0.203**	**0.098**	**0.233**	
	(0.040)***	(0.043)***	(0.132)	(0.137)*	
Log (House value), t-10	-1.127	-1.440	-2.347	-2.202	-1.405
	(0.133)***	(0.123)***	(0.133)***	(0.124)***	(0.125)***
Log (% Share of College Graduates), 1951					**0.131**
					(0.038)***
	PANEL B. Dependent variable is growth in Rental price				
Log (% Share of College Graduates), t-10	**0.226**	**0.269**	**0.243**	**0.079**	
	(0.048)***	(0.053)***	(0.149)*	(0.094)	
Log (Rental price), t-10	-1.420	-1.545	-2.290	-2.287	-1.527
	(0.122)***	(0.100)***	(0.105)***	(0.081)	(0.099)
Log (% Share of College Graduates), 1951					**0.189**
					(0.041)***
	PANEL C. Dependent variable is growth in Wage				
Log (% Share of College Graduates), t-10	**0.047**	**0.043**	**0.047**	**0.063**	
	(0.014)***	(0.015)***	(0.073)	(0.069)	
Log (Wage), t-10	-1.060	-1.144	-1.653	-1.720	-1.144
	(0.065)***	(0.066)***	(0.081)***	(0.126)***	(0.067)***
Log (% Share of College Graduates), 1951					**0.028**
					(0.013)**
Year fixed effects	yes	yes	yes	yes	yes
Region fixed effects	no	yes	no	no	yes
City fixed effects	no	no	yes	yes	no
Other variables in Table 8	no	yes	yes	yes	yes
Observations	413	413	413	212	413
Cities	269	269	269	118	269

Table shows the impact of the log of the percent college graduates on the dependent variable at city-level. House value, rent and wage growth are measured as the log change in city fixed effects obtained as described in section 4.2 in the text. Standard errors, reported in parenthesis, have been adjusted for serial correlation within cities. ***, ** , * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

Table 14.
Human Capital and Growth: unraveling between productivity and quality of life growth, LLM

Share of spending on non-traded goods $(1-\mu)$	Coeff. used	Impact of human capital on growth in Productivity β^a	Quality of life β^q	Share of growth due to growth in quality of life. $\frac{\beta^q}{\mu\beta^a+\beta^q}$
0.31	$\hat{\beta}_{wage}$	0.05	0.004	0.10
0.43	$\hat{\beta}_{wage}$	0.05	0.017	0.37
0.31	$\hat{\beta}_{price}$	0.04	0.011	0.27
0.43	$\hat{\beta}_{price}$	0.04	0.023	0.41

Calculations of the parameters β^a and β^q are based on the formulas (11) and (12). All calculations use $\hat{\beta}_{emp}$= 0.08, $\hat{\beta}_{wage}$ = 0.03 and $\hat{\beta}_{price}$ = 0.10. Theoretically, the values of β^a and β^q should not change when either $\hat{\beta}_{wage}$ or $\hat{\beta}_{price}$ are used to determine their values. Empirically this occurs because our calibration does not satisfies perfectly the relationship $\hat{\beta}_{price} = \hat{\beta}_{emp} + \hat{\beta}_{wage}$. The estimates of the share of spending on non-traded good are obtained by using the methods described in the appendix B.3. Sources: see text.

Table 15.
Growth and Human Capital: within local labour market regressions.

	Dependent variable is growth in…		
	Employment	House Value	Rental price
Log (% Share of College Graduates), t-10	**0.042**	**0.160**	**0.180**
	(0.020)**	(0.060)***	(0.070)***
Log (Employment), t-10	-0.590		
	(0.013)***		
Log (House value), t-10		-1.931	
		(0.162)***	
Log (Rental price), t-10			-2.034
			(0.132)***
Year fixed effects	yes	yes	yes
LLM fixed effects	yes	yes	yes
Other variables in Table 8	yes	yes	yes
Observations	1326	413	413
Cities	442	269	269
R-squared	0.695	0.767	0.895

Table shows the impact of the log of the percent college graduates on the dependent variable at city-level controlling for the average growth rate of the local labor market to which the city belongs. House value and rent growth are measured as the log change in city fixed effects obtained as described in section 4.2. Standard errors, reported in parenthesis, have been adjusted for serial correlation within cities. ***, ** , * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

Table 16.
The North-West case: testing the reinvention hypothesis

PANEL A	Dependent variable is growth in…	
	Share of manufacturing 1951-2001	Employment 1951-2001
Log (% Share of College Graduates), 1951	-0.031	0.002
	(0.097)	(0.012)
Log (% Share of Workers in Manufacturing), 1951	-0.321	-0.016
	(0.096)***	(0.012)
Log (Employment), 1951	-0.006	-0.018
	(0.031)	(0.005)***
Log (% Share Manu)*(% Share of Grads),1951	**-0.088**	
	(0.032)***	
Log (Employment)*(% Share of Grads),1951		-0.001
		(0.001)
Observations	438	438
R-squared	0.180	0.168

PANEL B	Dependent variable is ten-year growth in…			
	Employment	House Values	Rents	Wages
Log (% Share of College Graduates), t-10	0.053	0.295	0.438	0.031
	(0.024)**	(0.059)***	(0.067)***	(0.019)
Log (Employment), t-10	-0.026			
	(0.007)***			
Log (House value), t-10		-1.515		
		(0.117)***		
Log (Rental price), t-10			-1.634	
			(0.092)***	
Log (Wage), t-10				-1.146
				(0.067)***
Log (% Share of Workers in Manufacturing), t-10	0.079	0.028	0.019	-0.001
	(0.024)***	(0.053)	(0.068)	(0.029)
Log (% Share of Workers in Services), t-10	-0.014	-0.070	-0.176	-0.019
	(0.014)	(0.129)	(0.114)	(0.052)
Log (% Share of Workers in Trade), t-10	0.274	-0.114	0.029	-0.036
	(0.036)***	(0.078)	(0.105)	(0.035)
Log (% Share of Immigrants), t-10	0.015	0.179	0.435	-0.100
	(0.017)	(0.097)*	(0.136)***	(0.027)
Log (% Share of Imms)*(% Share of Grads), t-10	**-0.027**	**-0.102**	**-0.196**	**0.016**
	(0.015)*	(0.046)**	(0.051)***	(0.015)
Year fixed effects	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes
Observations	1326	413	413	413
Cities	442	269	269	269
R-Squared	0.624	0.615	0.694	0.647

House value, rent and wage growth are measured as the log change in city fixed effects obtained as described in section 4.2. Standard errors, reported in parenthesis, have been adjusted for serial correlation within cities. ***, ** , * denote significance at the 1%, 5%, 10% level respectively. Sources: see text..

Table 17.
Effect of quality of life on the wage: interactions of quality of life variables and human capital.

Dependent variable is log (Wage)

Independent variable is:	(1) Public transportation	(2) Health services	(3) Local bureaucracy	(4) Traffic congestion	(5) Air quality	(6) Nursery
	-0.014	0.004	0.020	-0.016	-0.001	0.003
	(0.0075)*	(0.011)	(0.011)*	(0.008)**	(0.011)	(0.017)
Interaction with human capital dummies:						
High school	0.022	0.040	0.022	0.023	0.009	0.006
	(0.019)	(0.020)**	(0.022)	(0.013)*	(0.019)	(0.029)
College	0.070	-0.004	0.031	0.023	-0.005	-0.024
	(0.048)	(0.038)	(0.047)	(0.033)	(0.039)	(0.050)
Postgraduate education	-0.093	-0.204	-0.267	-0.103	-0.136	0.010
	(0.051)**	(0.095)**	(0.061)***	(0.061)*	(0.079)*	(0.131)
Additional controls	yes	yes	yes	yes	yes	yes
Observations	2757	2944	2966	2995	3000	2174
R-squared	0.316	0.350	0.319	0.310	0.348	0.324

Table 17.
Continued

Dependent variable is log (Wage)

Independent variable is:	(7) Primary and secondary School	(8) Street cleaning	(9) Green Areas	(10) Safety and crime control	(11) Shopping possibilities	(12) Leisure activities (cinemas, theatres, museums,..)
	-0.036	-0.015	-0.010	-0.019	-0.020	-0.017
	(0.018)**	(0.008)*	(0.010)	(0.010)*	(0.011)*	(0.008)**
Interaction with human capital dummies:						
High school	0.017	0.022	0.017	0.011	0.009	0.012
	(0.033)	(0.021)	(0.019)	(0.020)	(0.026)	(0.017)
College	0.028	0.031	0.017	0.011	0.033	-0.013
	(0.053)	(0.043)	(0.035)	(0.041)	(0.070)	(0.033)
Postgraduate education	0.130	-0.052	-0.166	-0.276	-0.139	-0.199
	(0.136)	(0.105)	(0.091)*	(0.097)***	(0.146)	(0.103)**
Additional controls	yes	yes	yes	yes	yes	yes
Observations	2421	2947	2947	2922	2953	2899
R-squared	0.350	0.354	0.353	0.349	0.353	0.355

Table shows the effect of several indexes of quality of life on the (log) wage and the cross-effect of these indexe with human capital. The indipendent variables are the intervieweds' subjective evaluations (1 for lowest satisfaction and 10 for highest satisfaction) for these city's attributes. Additional controls are: the variable $(1-\mu)\ dlogP_i$ where $(1-\mu)$ is set to 0.31 and observable worker characteristics. The latter include: age, age squared and civil status. Robust standard errors are reported in parenthesis. ***, ** , * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

Table 18.
Effect of job satisfaction on the wage: interactions of job satisfaction indicators and human capital.

Dependent variable is log (Wage)

Independent variable is:	(1) Job satisfaction (Overall Index)	(2) Enviromental conditions (physics and social)	(3) Danger to life or health	(4) Effort Required	(5) Interestingness	(6) Considertion by others	(7) Concern about losing your employment
	0.047	0.074	-0.025	0.033	0.067	0.065	-0.066
	(0.028)*	(0.032)**	(0.012)**	(0.035)	(0.037)*	(0.032)**	(0.016)***
Interaction with human capital dummies:							
High school	0.053	0.012	0.011	0.006	0.018	0.015	0.029
	(0.025)**	(0.042)	(0.022)	(0.047)	(0.044)	(0.041)	(0.021)
College	-0.102	-0.142	0.028	-0.025	-0.077	-0.114	0.020
	(0.059)*	(0.058)**	(0.033)	(0.074)***	(0.043)*	(0.058)**	(0.031)
Postgraduate education	-0.140	-0.324	-0.246	-1.024	0.062	-0.220	0.127
	(0.178)	(0.188)*	(0.160)	(0.615)*	(0.347)	(0.077)***	(0.115)
Additional controls	yes	yes	yes	yes	yes	yes	yes
Observations	3058	3054	3059	3060	3059	3048	3054
R-squared	0.460	0.460	0.456	0.458	0.460	0.457	0.459

Table shows the effect of several indexes of quality of job on the (log) wage and the cross-effect of these indicators with human capital. The indipendent variables are the intervieweds' subjective evaluations (1 for lowest satisfaction and 5 for highest satisfaction) for job satisfaction indicators. Additional controls are: the variable $(1-\mu)\ dlogP_i$ where $(1-\mu)$ is set to 0.31 and observable worker characteristics. The latter include: age, age squared and civil status. Robust standard errors are reported in parenthesis. ***, ** , * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

Growth in Italian Cities
Appendices.

Appendix A. Employment growth-education relationship: Robustness checks.

Table A.1
City Growth and Human Capital: Robustness tests.

	Ten-year employment growth: log(employment,t/employment,t-10)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log (% Share of College Graduates), t-10	**0.061**	**0.065*** **	**0.061*** **	**0.075*** **	**0.087*** **	**0.104** **	**0.152*** **	**0.235*** **
	(0.018)***	(0.019)	(0.020)	(0.019)	(0.033)	(0.048)	(0.042)	(0.051)
Log (Employment), t-10	-0.261	-0.255***	-0.209***	-0.267***	-0.755***	-0.789***	-0.760***	-0.442***
	(0.044)***	(0.041)	(0.041)	(0.041)	(0.074)	(0.100)	(0.088)	(0.052)
Log (% Share of Workers in Manufacturing), t-10	0.076	0.073***	0.036	0.074***	0.013	-0.032	0.015	0.038**
	(0.024)***	(0.022)	(0.023)	(0.022)	(0.034)	(0.041)	(0.034)	(0.019)
Log (% Share of Workers in Services), t-10	-0.016	-0.026*	-0.028**	-0.029**	-0.008	-0.040	0.001	-0.037
	(0.016)	(0.014)	(0.014)	(0.014)	(0.042)	(0.048)	(0.042)	(0.036)
Log (% Share of Workers in Trade), t-10	0.099	0.112***	0.073**	0.104***	-0.021	-0.029	-0.061	0.064
	(0.038)**	(0.036)	(0.037)	(0.036)	(0.065)	(0.090)	(0.074)	(0.040)
Log (Restaurants and Hotels per 100 inhabitants), t-10	-0.022							
	(0.019)							
Log (Museums and Ricreational Estab. per 100 inh.), t-10	0.012							
	(0.010)							
Log (Membership Organizations per 100 inhabitants), t-10	-0.002							
	(0.011)							
Log(% Electoral turnout), t-10		0.002						
		(0.014)						
Log (Population), t-10				0.223				
				(0.157)				
Lagged Age Distribution	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Year-Region fixed effects	no	no	yes	no	no	no	no	no
City fixed effects	no	no	no	no	yes	yes	yes	no
Observations	1233	1326	1326	1326	456	325	384	483
Cities	436	442	442	442	164	120	128	161
R-squared	0.668	0.648	0.690	0.649	0.238	0.268	0.248	0.854
Estimation model	OLS	OLS	OLS	OLS	OLS	OLS	OLS	2SLS

Standard errors, reported in parenthesis, have been adjusted for serial correlation within cities. ***, ** , * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

Table A.2
LLM Growth and Human Capital: Robustness tests.

Ten-year employment growth: log(employmenti,t/employmenti,t-10)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log (% Share of College Graduates), t-10	**0.044**	**0.069*** **	**0.049** **	**0.065*** **	**0.117*** **	**0.145*** **	**0.137*** **
	(0.019)***	(0.021)	(0.021)	(0.021)	(0.043)	(0.053)	(0.052)
Log (Employment), t-10	-0.124	-0.443***	-0.397***	-0.458***	-0.733***	-0.755***	-0.722***
	(0.049)**	(0.047)	(0.045)	(0.048)	(0.081)	(0.100)	(0.092)
Log (% Share of Workers in Manufacturing), t-10	0.050	0.106***	0.030	0.098***	0.016	0.003	-0.009
	(0.019)***	(0.019)	(0.021)	(0.018)	(0.037)	(0.047)	(0.044)
Log (% Share of Workers in Services), t-10	0.151)	0.041	0.025	0.030	-0.024	0.006	0.003
	(0.058)***	(0.025)	(0.026)	(0.025)	(0.037)	(0.047)	(0.044)
Log (% Share of Workers in Trade), t-10	-0.027	0.073*	-0.015	0.062*	-0.006	-0.048	-0.025
	(0.039)	(0.038)	(0.036)	(0.037)	(0.075)	(0.089)	(0.082)
Log (Restaurants and Hotels per 100 inhabitants), t-10	-0.058						
	(0.028)**						
Log (Museums and Ricreational Estab. per 100 inh.), t-10	0.022						
	(0.015)						
Log (Membership Organizations per 100 inhabitants), t-10	-0.021						
	(0.014)						
Log(% Electoral turnout), t-10		-0.014*					
		(0.008)					
Log (Population), t-10				0.485***			
				(0.122)			
Lagged Age Distribution	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes	yes	yes	yes
Year-Region fixed effects	no	no	yes	no	no	no	no
LLM fixed effects	no	no	no	no	yes	yes	yes
Observations	831	831	831	831	388	300	324
LLMs	277	277	277	277	134	103	324
R-squared	0.830	0.827	0.859	0.823	0.963	0.962	0.963
Estimation model	OLS	OLS	OLS	OLS	OLS	OLS	OLS

Standard errors, reported in parenthesis, have been adjusted for serial correlation within cities. ***, ** , * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

Appendix B: Local Area Wages, House Value, Rents and the Share of Spending on Housing.

B.1 Measuring Local Area House Value and Rents.

In order to measure relative house value in cities in 1986, 1991 and 2000, we regress the log of the value of all dwellings reported in SHIW at time t on dummies for cities and a set of controls. The dependent variable and the housing characteristics we used are described below (SHIW variable name in parentheses).

- House Value (VALABIT). SHIW reports the value of four types of real estate: dwelling (code 1); other building (code 2); agricultural land (code 3); and not agricultural land (code 4). We limit our sample to only dwellings. The sample is trimmed at the 1st and 99th percentile of the distribution of dwellings value.

Set of controls:

- Surface in square meters (SUPAB).

- An indicator variable equal to one if two or more bathrooms are available in the dwelling (BAGNI). This variable is not available for the years 1991 and 1986.

- An indicator variable equal to one if an heating system is available in the dwelling (RISCALD). This variable is not available for the years 1991 and 1986.

- Year built (ANCOSTR). This variable contains the construction year of the dwelling.

- House's location (UBIC1). This variable indicates the position of the dwelling as follows: coutryside, isolated area (code 1); town outskirts (code 2); area between outskirts and city center (code 3); city center (code 4); other (code 5); and hamlet (code 6). In 1991 and 1986 we used the variable (UBIC) rather than (UBIC1).

- Dwelling's category (CATABIT). The categories are: luxury (code 1); upscale (code 2); mid-range (code 3); modest (code 4); low-income (code 5); very-low income (code 6); rural (code 7); and other (code 8).

- Use status (USOIMM). The categories are: main dwelling (code 1); vacation residence (code 2); professional or commercial use (code 3); rented out to individuals or households during the whole year (code 4); rented out to companies during the whole year (code 5); rented out to individuals or households in a part of the year (code 6); rented out to companies in a part of the year (code 7); not rented out (code 8); other (code 9).

In order to obtain rents in cities in 1986, 1991 and 2000, we regress the log of annual rent of all dwellings in the sample in each year on dummies for cities and the set of controls described above.
For each household, the interviewed can be either the tenant or the property owner. In the case the interviewed is the tenant, SHIW reports the actual rent paid by the tenant. If the interviewed is the property owner, SHIW collects the rent the owner charges. In both cases the variable of interest is called (AFFEFF). If the interviewed is the property owner but the dwelling is not rented or it is the family residence, SHIW reports her best estimate for the rent she could charge (AFFIMP).
Since the two conditions are mutually exclusive and in order to get a complete series of annual rents we combine the two variables. Our sample of annual rents is restricted to dwellings and it is trimmed at the 1st and 99th percentile of the distribution of rents.

We repeated the same procedure to calculate the house value and annual rents for LLMs.

B.2. Measuring Local Area Wages

In order to measure relative hourly wage levels in cities at time t, we regress the log of hourly wage of all workers of age between 15 and 65 in the sample at time t on dummies for cities and a set of controls. In what follows we describe each variable in detail (SHIW variable name in parentheses).

- Hourly wages are calculated by dividing the annual earnings by the total amount of hours worked in a year. Annual earnings are those from any activity as employee, including fringe benefits net of taxes an social security contributions (YLM+YLNM). We obtain the total amount of hours worked in a year as average hours worked per week * months worked * 4.3333 (ORETOT * MESILAV * 4.3333). The sample is trimmed at the 1st and 99th percentile of the distribution of hourly wages.

Set of controls:

- Age in years (ETA) and the square of age in years.

- Civil status (STACIV). The categories are married (code 1); never married or single (code 2); separated or divorced (code 3) and widowed (code 4);

- Educational attainment (STUDIO). The categories, which correspond to completed years of schooling are: none (code 1); primary school (code 2); lower secondary school (code 3); upper secondary school (code 4); university degree (code 5) and postgraduate education (code 6). Observations with missing data on educational attainment were dropped from the hourly wage regression.

- Sector of economic activity (SETTP9). The categories are: agriculture (code 1); industry (code 2); construction (code3); wholesale and retail trade, business and repair services, hotel and restaurants (code 4); transportation and telecommunications (code 5); finance and insurance (code 6); real estate, professional and related services (code 7); public administration and other public and private services (code 8); and not professional condition (code 9). We chose SETTP9 because this variable was available for all the years we were interested in. Observations with missing data on sector of actvity were dropped from the hourly wage regression.

- Occupational category (QUALP10). This variable divides workers into two groups: employees and self-employed/employers. Since our dependent variable is hourly wage as employee, we restict the sample to employees. The categories are: laborer (code 1); employee or teacher (code 2); mid executive level manager (code 3), manager (code 4). The variable (QUALP10) is not available for the year 1987 so we used for this year the variable (QUALP7N). Codes and categories do not change at all. Observations with missing data on occupation were dropped from the regression.

We repeated the same procedure to measure relatively hourly wage levels in LLMs.

B.3. Estimating the share of spending on housing prices.

The first strategy we employ to estimate the parameter $(1-\mu)$ is to use the micro-data in the SHIW. The archive (CONS) reports the total consumption for 15191 individuals. We match this dataset with the archives (COMP) which contains information about consumers' characteristics. We focus on the year 2000. We regress the log of the annual total consumption on both the log of the annual rent and the log of the house value.[1] Table (B.3.1) presents the results of this exercise. Column 1 shows an elasticity of 0.35 percent when the housing price is included as the only regressor. A one percent increase in the implicit price of land increases the consumption expenditure by 0.35 percent. This elasticity becomes approximately 0.31 percent when we control for individuals' characteristics (column, 2). Results are similar when the rental price rather than house value is used as regressor. (columns, 3 and 4).

The second way of estimating $(1-\mu)$ is to use a city-level price index and regress the log of this price index on the log of the rental price. ISTAT makes two price indices available for 70 large cities: the FOI (blue and white collar workers price index) and the NIC (based on the total population).[2] We use the FOI because it is the official price index used to adjust rents. Table (B.3.2) shows that a one percent increase of rental price raises the cost of living by about 0.33 percent (column, 1). As we argued in the paper, the rental price coefficients could be biased if there are some omitted characteristics of the dwellings or because of measurement error. To deal with these potential concerns and following Shapiro (2006), we use the housing price as instrument for the rental price. Column 2 in Table (B.3.2) shows that the estimate increases to 0.427 percent consistent with the presence of measurement error in the first column.

Together, these two methods confirm that a reasonable estimate of the share of spending on non-traded goods lies between 0.31 and 0.43. In the paper we use both of these values.

Table B.3.1
The impact of the housing price on the total consumption, 2000.

	Dependent variable: log (Total Consumption)			
	(1)	(2)	(3)	(4)
Log (House value)	**0.351** (0.007)***	**0.307** (0.006)***		
Log (Rental price)			**0.365** (0.008)***	**0.312** (0.008)***
Individual's characteristics listed in section A.1	no	yes	no	yes
Observations	15191	15191	15191	15191
R-squared	0.215	0.320	0.217	0.323

Robust standard errors are reported in parenthesis. ***, ** , * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

[1] We construct the series of the annual rent and house value as explained in the section B.1

[2] At the city-level, the FOI is available from 1996 onwards; the NIC from 1999 onwards. We combine 70 cities of our sample with the FOI dataset in the year 2000.

Table (B.3.2)
The impact of the rental price on the cost of living, 2000.

	Dependent variable: log (FOI cost of living index)	
	(1)	(2)
Log (Rental price)	**0.334**	**0.427**
	(0.012)***	(0.019)***
Observations	70	70
R-squared	0.460	
Estimation method	OLS	2SLS

Robust standard errors are reported in parenthesis. ***, ** , * denote significance at the 1%, 5%, 10% level respectively. Sources: see text.

Appendix C: Data Appendix

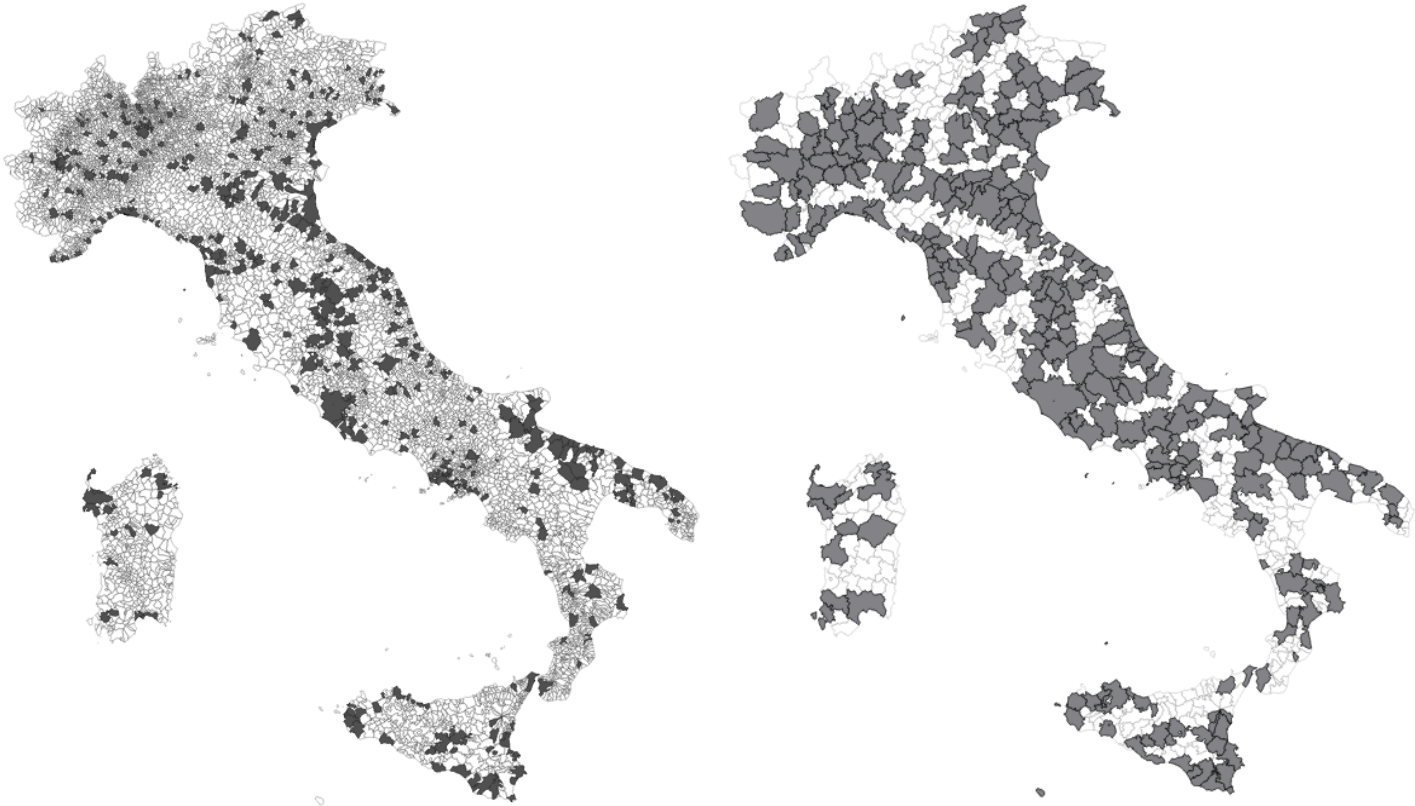
Table (C.1)
Data description.

Variable	Description and Source
Population	Data refer to resident population. Population Censuses 1861-2001, ISTAT. The 1891 and the 1941 population Censuses were not carried out because of financial difficulties in the first case and WWII in the second one. From 1971 to 2001 data on population are from "Atlante Statistico dei Comuni", ISTAT.
(Total) Employment	Employment is the sum of all workers over the ISTAT economic activities' classification "Ateco". Agricultural workers are not taken into account. Industrial and Commercial Censuses 1911-2001, ISTAT. Data for 1911 are from Industrial Census, 1911, Vol. I, Table 1 and Vol. IV, Table IV.a. Data for 1927 are from Industrial and Commercial Census, 1927, Vol. V and Vol.1. Data for 1951 are from Industrial and Commercial Census, 1951, Vol.1. From 1971 to 2001 data on employment are from "Atlante Statistico dei Comuni", ISTAT.
Share workers in manufacturing	Employment in manufacturing over total employment. Industrial and Commercial Census, 1951-2001, ISTAT. From 1971 to 2001 data are from "Atlante Statistico dei Comuni", ISTAT. Ateco Section: D
Share workers in services	Employment in services over total employment. Industrial and Commercial Census, 1951-2001, ISTAT. From 1971 to 2001 data are from "Atlante Statistico dei Comuni", ISTAT. Ateco Sections: K and M
Share workers in trade	Employment in trade over total employment. Industrial and Commercial Census, 1951-2001, ISTAT. From 1971 to 2001 data are from "Atlante Statistico dei Comuni", ISTAT. Ateco Section: G
Share of college graduates	Number of persons with a university degree over population. Population Census, 1951-2001, ISTAT. From 1971 to 2001 data are from "Atlante Statistico dei Comuni", ISTAT.
Local area wages	Obtained as the cities (or LLMs) fixed effects of indipendent cross-sectional regressions where we control for age, age squared, civil status dummies, education dummies, sector of economic activity dummies and occupation category dummies. SHIW, 1987, 1991, 2000, BANCA D'ITALIA
Local area house value	Obtained as the cities (LLMs) fixed effects of indipendent cross-sectional regressions where we control for surface, number of bathrooms, presence of an heating system, year of construction, location dummies, category dummies and use status dummies. SHIW, 1986, 1991, 2000, BANCA D'ITALIA
Local area rents	Obtained as the cities (LLMs) fixed effects of indipendent cross-sectional regressions where we control for surface, number of bathrooms, presence of an heating system, year of construction, location dummies, category dummies and use status dummies. SHIW, 1986, 1991, 2000, BANCA D'ITALIA
Restaurants & hotels per 100 inhabitants	Number of Restaurants and Hotels over population (*100). Data are from "Atlante Statistico dei Comuni". Ateco Section: H
Museums & recreati-onal establishments per 100 inhabitants	Number of museums and recreational establishments over population (*100). Data are from "Atlante Statistico dei Comuni". Ateco Section: O, Two-Digit Code: 92.
Membership Org. per 100 inhabitants	Number of associative organizations over population(*100). Data are from "Atlante Statistic dei Comuni". Ateco Section: O, Two-Digit Code: 91
Electoral turnout	Obtained as the ratio between actual and eligible voters for the election of the Italian Chamber of Deputies. As census and election years did not correspond, the closest time match has been found. i.e. census years in the 1961-1991 span have been associated to the following election years: 1963, 1972,1983,1992. Data are from the Italian Ministry of Interiors.
Share of High school	Number of persons enrolled in a high school over population in 1931. "Annuario delle Città

enrollment in 1931	Italiane", Parte II, 1934. Istituto Nazionale di Urbanistica.
FOI, price index.	Blue and white collar workers price index. http://dati.istat.it/
Share of Immigrants	Number of people who moved to a city from another one over population. Foreign immigrants are not taken into account. "Popolazione e Movimento Anagrafico dei Comuni". ISTAT.

Figure (C.1)
The distribution of the cities and LLMs on Italian territory.

CITIES LLMs



Cities with more than 50,000 inhabitants in 2001:

Torino, Moncalieri, Novara, Cuneo, Asti, Alessandria, Busto Arsizio, Legnano, Varese, Como, Monza, Cinisello Balsamo, Rho, Milano, Sesto San Giovanni, Bergamo, Brescia, Pavia, Vigevano, Cremona, Bolzano, Trento, Verona, Vicenza, Treviso, Chioggia, Venezia, Padova, Rovigo, Udine, Trieste, Sanremo, Savona, Genova, La Spezia, Piacenza, Parma, Reggio nell' Emilia, Carpi, Modena, Bologna, Imola, Ferrara, Faenza, Ravenna, Cesena, Forlì, Rimini, Carrara, Massa, Lucca, Viareggio, Pistoia, Scandicci, Firenze, Livorno, Pisa, Arezzo, Siena, Grosseto, Prato, Foligno, Perugia, Terni, Fano, Pesaro, Ancona, Ascoli Piceno, Viterbo, Civitavecchia, Guidonia Montecelio, Roma, Latina, Aprilia, L'aquila, Teramo, Pescara, Chieti, Campobasso, Aversa, Caserta, Benevento, Castellammare di Stabia, Marano di Napoli, Giuliano in Campania, Ercolano, Portici, San Giorgio a Cremano, Napoli, Pozzuoli, Casoria, Afragola, Torre del Greco, Avellino, Cava de' tirreni, Battipaglia, Salerno, Cerignola, Foggia, Manfredonia, San Severo, Altamura, Bari, Bitonto, Barletta, Andria, Trani, Bisceglie, Molfetta, Taranto, Brindisi, Lecce, Potenza, Matera, Cosenza, Catanzaro, Lamezia Terme, Reggio di Calabria, Crotone, Mazara del Vallo, Marsala, Trapani, Bagheria, Palermo, Messina, Caltanissetta, Gela, Acireale, Catania, Modica, Ragusa, Vittoria, Siracusa, Sassari, Quartu Sant'Elena, Cagliari.

LLMs with more than 100,000 inhabitants in 2001:

Cirie, Torino, Novara, Alba, Cuneo, Asti, Alessandria, Biella, Busto Arsizio, Varese, Como, Milano, Seregno, Bergamo, Brescia, Pavia, Vigevano, Cremona, Mantova, Lecco, Lodi, Bolzano, Trento, Verona, Arzignano, Bassano del Grappa, Vicenza, Castelfranco Veneto, Conegliano, Treviso, San Donà di Piave, Venezia, Padova, Udine, Gorizia, Trieste, Pordenone, Savona, Chiavari, Genova, La Spezia, Piacenza, Parma, Reggio nell' Emilia, Carpi, Modena, Sassuolo, Bologna, Ferrara, Ravenna, Cesena, Forlì, Rimini, Lucca, Viareggio, Pistoia, Firenze, Livorno, Pisa, Pontedera, Arezzo, Siena, Montevarchi, Prato, Perugia, Terni, Fano, Pesaro, Ancona, Ascoli, San Benedetto del Tronto, Viterbo, Roma, Velletri, Formia, Latina, Cassino, Frosinone, Avezzano, Pescara, Atessa, Campobasso, aversa, Caserta, Benevento, Castellammare di Stabia,Napoli, Nola, Torre del Greco, Avellino, Nocera Inferiore, Salerno, Foggia, Altamura, Bari, Barletta, Bisceglie, Taranto, Brindisi, Lecce, Potenza, Cosenza, Catanzaro, Lamezia Terme, Reggio di Calabria, Crotone, Marsala, Trapani, Palermo, Messina, Agrigento, Caltanissetta, Gela, Acireale, Catania, Modica, Augusta, Sassari, Cagliari.

Brain Gain in the Age of Mass Migration

Francesco Giffoni* and Matteo Gomellini**

Abstract

The relationship between emigration and human capital is a hotly debated issue. Nowadays discussions focus mainly on the so called *brain drain*, i.e. the reduction in the human capital endowment of a country due to emigration of high skilled people. Differently, this paper investigates whether and how the Italian emigration of the early twentieth century induced a domestic increase in schooling proxied by primary school attendance rates. Many historical evidences stress that this actually happened in Italy at the turn of the XIX century and at least three rationales lie at the heart of such a relationship. First, emigration or its prospects could increase the expected return to schooling, thus making education more attractive; second, return migration could fuel a rise in school attendance via monetary and non-monetary channels; third, remittances could help in relaxing the budget constraint that prevented people to invest in education. Using a new dataset at the city level and different econometric techniques, we find quantitative support that primary school attendance rates have been positively correlated with (and arguably in part caused by) emigration and return migration. We also find a positive effect on schooling associated with a rough proxy of remittances.

JEL Classification: F22, N33, O15
Keywords: Migration, Brain Gain, Schooling.

Contents

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1 Introduction[1]

Migration can act as an equilibrating force that fosters convergence between regions and countries, with the effect of offsetting pre-existing disparities. The mechanism is similar to the one predicted by Heckscher and Ohlin in their theory on international trade (Harris and Todaro, 1970)[2]: thanks to the movements of people and goods, relative prices tend to level off in different countries.

For several reasons, the impact of emigration on sending countries is a relatively poorly studied issue with respect to the impact of immigration in host countries. When analyzed, the stress is often put on the so called brain drain phenomenon: if people who move out of a country are the most skilled, migration could damage native countries because of human capital depletion. By stressing on this point, traditional literature on brain drain has long labeled the loss of human capital as a *looting* that by reducing the human capital stock in sending countries could hamper the convergence in per capita income levels across countries (Bhagwati and Hamada, 1974; Bhagwati and Wilson, 1989; Piras, 2007; Ciriaci, 2005).

In contrast with this traditional view, recent theoretical and empirical literature recognizes that the experience of migration, or only the prospects of it, can make explicit the importance of education favoring schooling of both adults and children (brain gain) and points out the channels through which migration may positively influence the human capital endowment in source countries. In particular, three main channels could be identified (Mayr and Peri, 2008; Docquier and Rapoport, 2009): the first operates through migration or its prospects; the second through return migrants; the third through remittances. This paper is a first attempt of investigating along these lines.

The analysis proceeds as follows. In section 2 we make a short review of the existing literature. In section 3 we describe the three information pillars on which our analysis is built: a solid qualitative and historical evidence that tells us about the possible mechanisms at work; the description of the structure of Italy's public education system; a new dataset that reports figures at the city level. We also present some descriptive evidences on the patterns of outflows (inflows) from (to) Italian cities as well as on school attendance. In section 4 we describe our identification strategy and we get to an empirical model in reduced form to be estimated. We divide this section in three subsections: in the first we test the relationship between attendance rates and emigration (returns) in a specification where in-and out-migration are used as the only predictors for attendance. Then, we try to deal with endogeneity issues by using an IV approach. In particular we exploit the shipping lines' transportation costs as instrument. Last, we estimate a multivariate model with a GMM technique.

The main results are the following: 1) for the first decade of the twentieth century migration and return migration could have caused part of the increase in primary school

[1]We are grateful to Antonio Accetturo, Alberto Baffigi, Federico Barbiellini Amidei, Elio Cerrito, Alfredo Gigliobianco, Claire Giordano, Paolo Sestito, Francesco Vercelli, Eliana Viviano, Jeffrey Williamson and an anonymous referee for comments and support. We also thanks participants at the First CEPR Economic History Symposium held in Perugia, April 2013. This work has benefited from the great help of Ivan Triglia, Sandra Natoli, Antonella Maria Pulimanti and Rita Anselmi. All errors remain our own. The opinions herein expressed are solely of the authors.

[2]Heckscher and Ohlin predictions were fomalized by Stolper and Samuelson (1941).

attendance; 2) we detect a positive effect on schooling associated with a rough proxy of remittances; 3) when controlling for fixed effect at the city level, we do not find differential effects between the South and the North of Italy. In Section 5 we turn elasticities into figures that tell us how many people migration kept at school. Section 6 concludes.

2 Brain gain: how does it work?

This work focuses on the three key channels that have been the subjects of both historical and contemporary analysis and have stressed on the association between migration and education:

- *emigration and its prospects* can boost the incentives for education in the source country. This happens because the usefulness of basic education is rightly perceived as having a great importance for different reasons (necessity of writing home, remittances bookkeeping, expected school-premia in wages, defense from being cheated);

- *return migrants* could foster education to the extent that returnees, thanks to their experience abroad, are more sensitive to the importance of schooling.

- *remittances* can play an important role in relaxing a possible budget constraint that prevents people to invest in education.

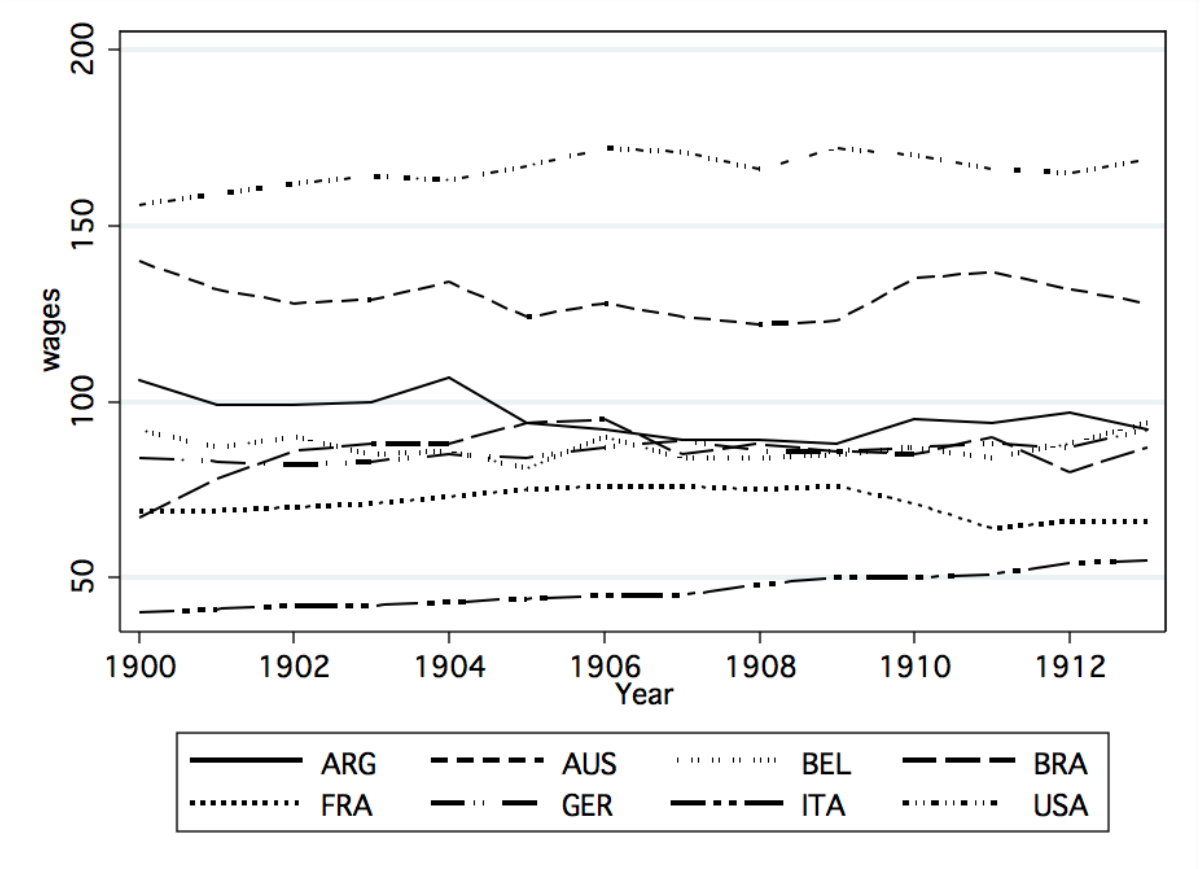
The first mechanism emphasizes the fact that potential migrants base their decision to leave on the comparison of future expected incomes abroad and at home (among other push and pull factors)[3]. Historical and contemporary literature seems to agree that the magnitude of this incentive depends mainly on the income and /or wage gap between source and destination countries; the greater the gap, the stronger the motivation to leave.

What was the magnitude of this gap? Figure 1 plots the average unskilled salary in Italy between 1900 and 1913, compared to that of some European and transoceanic countries which at the time were the preferred destinations of Italian migrants. In Italy, the average wage was the lowest one and the gap between Italy and the U.S. overcame 100 points. Furthermore, the skill premium, i.e. the ratio between skilled and unskilled wages, was higher in U.S with respect to Italy (Betran and Pons, 2004). In this respect, potential leavers commitment to acquire basic education was in order to get this possible wage increase once arrived at destination. In doing so, they could generate a brain gain since the probability to emigrate (for the most educated) is likely to be less than one, i.e. a perfect selection among migrants does not occur. In early 20th century Italy, migratory outflows differed from those of the other European countries chiefly because of a lower literacy rate among emigrants due to the large number of poor Southerners.

The strand of migration literature that investigated on the brain gain dates at least

[3]See Hatton (2010) for a complete survey on the cliometrics of international migration. Gomellini and Ó Gráda (2013) propose an estimate of the determinants of emigration. Another paper that focuses on the Mass Migration Era is Bertocchi and Strozzi (2008). The authors emphasize, beside the role of economic and demografic factors, the role of institutional factors in the host countries in driving immigration. In the paper two separate sets of institutions are considered. The first fosuses on the political institutions, i.e. the level of democracy and the extension of suffrage; the second one focuses on migration institutions, i.e the kind of citizenship laws, land distribution policy, public education policy, and immigration policy attitudes. They find that both political and migration institutions positively contribute to the level of attractiveness of a country toward migrants.

Figure 1: International (unskilled) real Wage Indexes.



Source: Williamson, 1995

as far back as Mountford (1997): he emphasized the 'emigration prospects' transmission mechanism: the possibility of emigrating rises the expected return to schooling and render education more attractive, spurring investments in education. Theoretically and from the point of view of the source country, if return to education is greater in the latter than in the host country, then negative selection might be the result; vice versa, the greater the gap between incomes between sending and receiving economies, the more likely is the hypothesis that the more skilled will leave[4]. Brain gain will come forth to the extent that the probability to migrate is large enough to activate the channel and sufficiently low to avoid a total escape of brains (Stark et al., 1997, 1998; Beine et al., 2001; Lucas, 2004; Docquier and Rapoport, 2003, 2009; Egger and Felbermayr, 2009)[5].

[4]The economic theory suggests, moreover, that the higher the fixed costs of migration the more plausible the hypothesis of a selective migration because skilled individuals will be able to amortize costs more quickly. In the age of mass migration the cost of voyage from Italy to U.S., included the cost to reach the port of embarkation, was not negligible at all, although affordable. See Commissariato Generale dell' Emigrazione (1927), Fenoaltea (2002), Gomellini and Ó Gráda (2011) for a more detailed analysis

[5]The first laws on migration issued by the government of the Kingdom of Italy were inspired by a deliberately repressive philosophy, strongly limiting the possibility of leaving (The Menabrea law 1868; The Lanza law, 1873). These limitations were supported by the concerns of industrial groups in the

The incentive to invest in education is not only a theoretical curiosum but it has an empirical relevance (Mayr and Peri, 2008). For example Beine et al. (2001) find a positive and significant effect of migration prospects on human capital formation in a cross-section of 37 developing countries. This is confirmed by other macroeconomic studies such as Beine et al. (2011) who perform a panel data analysis to control for unobserved heterogeneity and for the endogeneity of emigration rate. They show that the channel works and it is stronger in low-income countries. Lucas (2004) shows that the brain gain caused by the possibility to leave exists at micro-level too. By observing the very high rates of enrollment in higher education in the Philippines, although the low domestic return to human capital, he argues that higher education is almost certainly induced to a significant extent by potential for emigration.

Even though this literature focuses heavily on skilled migration, in particular on tertiary educated migrants, there are strong parallels with historical studies which refers inevitably to primary educated, or literate, leavers.(Williamson, 2006).

Part of the economic literature views migration as a permanent phenomenon, particularly if referred to highly-skilled individuals (Becker et al., 2004; Monteleone and Torrisi, 2010; Biondo et al., 2012). Differently, when migration is a transitory event, return migration can have a positive influence on sending regions (Borjas and Bratsberg, 1996; Dustmann and Weiss, 2007; Mayr and Peri, 2008; Dustmann et al., 2011). Lalonde and Topel (1997) found that about one third of immigrants to the US between 1890 and 1957 returned home.

Dustmann and Weiss (2007) and Mayr and Peri (2008) suggest that the experience abroad increases the amount of individual human capital and therefore the level of productivity of the agents; as a result return migration can lead to a mitigation of the brain drain, or even the creation of a brain gain, to the extent returns bring into the home country raised skills. Furthermore Dustmann et al. (2011) extend the seminal work of Borjas (1989), introducing the idea that some countries can be seen as learning headquarters where individuals can acquire specific skills expendable in the native area. Under this assumption each return generates a human capital gain with beneficial impact on income.

In the age of mass migration, though most of migrants were away a long time, a significant proportion returned. According to Giusti (1965)[6] during the period 1811-1911 net migration was about one third of the gross flow. Hatton and Williamson (1998) suggest that the big surge in gross emigration after the 1890s was not matched by a big blood in net migration but was mainly a spurious result due to a change in passport regulation. Bandiera et al. (2012), using the Ellis Island archive, points to an underestimation of returnees figures in official data. Gomellini and Ó Gráda (2011) show the relative importance of return migration in the cases of the United States and Argentina by

North of the country and of landowners in the South: a large number of expatriates could create a shortage of cheap labor and, therefore, stimulate the growth of real wages. Other restrictions were introduced later to avoid the emigration as a practice to escape the conscription introduced immediately after the Unification (The Crispi law, 1988). It was only with the 1901 law, backed by Luttazzi and Pantano (two Italian politicians), that emigration became finally a free choice of the individual. See Einaudi (2007) for more details.

[6]For a close examination, see Gomellini and Ó Gráda (2011).

comparing gross migration flows and the number of Italian-born residents as recorded in the census. They find that a gross migration of over 0.6 million Italians during the 1890s led to an increase in the number of Italian-born of only 0.3 million in the U.S. between 1890 and 1900 while a gross outflow of 1.2 million in 1896-1914 yielded increases in the numbers of Italian-born of about 0.4 million in Argentina in the same period. Del Boca and Venturini (2003) argue that Italian emigrants did not settle permanently abroad. If during the first period of prevailingly transoceanic emigration (until 1895) the proportion of returns was relatively small, in a second phase (1896-1921), returns tended to be of sizable number. Yet, according to Coletti (1911) in the two-year period 1905-1906 the proportion of returns in Italy was, on average, 46 percent (41 and 52 percent respectively in the South and in the North) with respect to migrants left four years before.

This paper adds to existing literature new insights of the effects of migration on schooling in Italy in the first decade of the twentieth century, a period often referred to as the 'Age of Mass Migration'. Firstly we embrace the hypothesis according to which the prospect of emigration rises the expected income to schooling and as a consequence renders education more attractive. In second place we test the return migration transmission mechanism. Here the idea is that who returns could raise attendance, to the extent the returnees are more sensitive to the importance of education.

Differently from the official sources commonly used to empirically evaluate the role of migration on Italy's development,[7] we use a unique dataset at the city level which collects statistics on the social and economical life of the cities with more than 10,000 inhabitants at the time. The detailed records on the population and on education allows us to overcome many shortcomings of the existing historical studies. For example these studies fail at capturing the unobserved heterogeneity between units of analysis because of the use of cross-section regressions.

3 A three information pillars based investigation

At the core of our analysis there is the attempt of evaluating the effects of outward and return migration on primary school attendance rate in Italy during the first decade of 20th century. Our strategy is based on the following three pillars of information.

3.1 Historical evidences

The period that goes from the second half of the Nineteenth century to the outbreak of WWI is often referred to as the age of mass migration from Europe to the New World (Hatton and Williamson, 1998). In the early decades the phenomenon was mainly confined to migrants from North-West Europe and Italian emigration was limited. The progressive transport revolution made overseas trips safer and cheaper and co-determined a big surge of emigration to United States that lasted until the Great War. Between 1876 (when data on Italian emigration first become available) and 1914, Italy's emigration rate rose from 5 per thousand (of population) to nearly 25 per thousand. Nearly 14 million left and about two thirds left in the first decade of the twentieth century. Though a majority of migrants remained abroad, a significant but varying proportion returned. Official data on

[7] For example The Annuario Statistico della Migrazione Italiana dal 1876 al 1925 and IPUMS dataset.

returnees, available from 1905, show that on average, between 1905 and 1913 the yearly share of returnees on migrants was around 30 per cent (Gomellini and Ó Gráda, 2013).

As far as brain gain is concerned, there are plenty of qualitative evidences. Those given by Coletti (1911)[8],in particular, are striking. He argues that the migratory experience made explicit the usefulness of schooling to achieve higher salaries or reach better quality of life. Analyzing the overall impact of migration on Italy's development in the liberal age, he highlighted that

> Migration is the best friend of literacy [...]. It is the experience of migration that provided strong evidence about the utility of primary education as a powerful tool of an upward social mobility and it is undoubtedly the most persuasive deterrent to dropping out of primary school. [...] Migration is the main cause of the school attendance rate rise

This hypothesis is stressed also by Jarach (1877)[9] and Cipolla (1969) who argue that, notwithstanding the countless factors which hamper pupils of getting school, literary knowledge is crucial because of the need, once crossed the ocean, to send news on health and on the accumulation of savings to own family at home.

There are many qualitative evidences about the relationship between migration and education at the regional level. With respect to the Italy's region Abruzzi which, at the time, recorded high emigration rates and notable advancements in fighting against illiteracy, Jarach (1877) writes:

> The helpfulness of literacy is penetrated into the consciousness of the population. It has rapidly conquered the minds of farmers and shepherds because of the need, once crossed the ocean, to send news on health and on the accumulation of savings to the families at home, without relying on a stranger. From the U.S. come incitements to the wives to send children to school. [...].These facts are neither isolated nor rare.

In Sicily, the number of enrollments in the primary school increased remarkably in the first decade of 20th century. The enrollment rate raised from 54.5 per thousand inhabitants in 1902 to 73.5 in 1907. Coletti (1911) writes:

> Since there are no other causes being able to explain the event, the reason must be sought in the consciousness of people. Despite the hostility of the environment in which people live and their financial straits, finally individuals make themselves more confident that literacy may be an effective weapon against poverty. This firm conviction emerges thanks to emigration. It is emigration the main cause for the growth in the attendance rates.

Lucania was, at the time, the region with the highest emigration rate. The following words are drawn by Coletti (1911).

> In most municipalities there is a new common sense among peasants. They have a keen desire to send their children to school. To this end and very frequently, emigrants exhorted their own relatives at home so that their brothers (sisters), nephews (nieces) in order to go to school.

[8]Francesco Coletti (1866-1940) was an Italian statistician and economist.

[9]C. Jarach was a statistician. He was commissioned, among others, by the Ministry of Agriculture, Industry and Business to carry on the inquiry on the conditions in agriculture in the South of Italy. In particular, Jarach was in charge of the Italy's region Abruzzi.

In Calabria, where outflows were soaring, schools were becoming increasingly populated by pupils.

> Mothers clean up their children, take them to school and ask the teacher for their children to learn as much as possible. This is because fathers write from the U.S. that their children have to be educated. Only through the migratory experience fathers realize the damage from being illiterate (Coletti, 1911).

As regards northern Italy, Cipolla (1969), analyzing the high literacy rate among the population living in the Alpine areas on the border with Austria, Switzerland and France, argues that literacy is triggered off by emigration which forces potential migrants to become literate in order to keep in touch with relatives.

The second mechanism we investigate, stresses on the fact that return migrants, having acquired in their experience abroad augmented skills, are more capable of perceiving education as a tool to achieve success and prosperity; as a result they may foster school attendance. The returnees channel is well documented by qualitative literature too. Coletti (1911) writes:

> who returns from America is a human being transformed and able to transform [...]. He embodies the old village-like soul which was renewed by the American economy and society so he can bring a new energy in the country to which he returns. The depth of the trasformation that emigration will be able to cause in Italy will strongly depend on his physical and mental conditions.[10]

Coletti (1911) 's testimony clearly shows migrants' ability to learn from abroad experiences: *"Emigration is a great school; it embodies [...] thousands of thousands of scholarships. It gets rid of the old rust from the mind, it inculcates ideas that otherwise would not be able to penetrate"*. Return migrants were psychologically changed with respect to the time they left. Ease, fluency and manner of speaking, style of dress, greater awareness of their own dignity and their rights, no awe of the old employers, the desire to deal with municipal affairs, political and general interests are just a few traits of people who came back from abroad. *"It is a miracle occurred thanks to migration. [...]. The awakening of the consciences promote the diffusion of literacy amongst peasants"*.

As evident, the social life of a community is so closely tangled within its components that is extremely difficult to isolate the determinants of a certain phenomenon from other possible causes. For this reason we need some additional clarifications to better identifying our transmission channels.

According to the first channel, the prospects of emigration are incentives for both adults (parents) and children to go to school. This does not mean that children were able to make decisions on their own, but simply that parents, or somebody else, made decisions on behalf of children. We try to separate the impact of migration on children and on adults education by distinguish the effect of migration on the attendance rate

[10] Clearly the effect of returns on the sending country depends on the health of returned migrants, on the investments they implement in the native country and on the amount of savings accumulated abroad. For example Cerase (1967), in his research on returns from USA, shows a discouranging scenario in the South. He finds out that 19 per cent returned because their migratory project failed, 40 per cent because their savings plans were reached, 26 per cent for retirement and only 16 per cent to invest in the area of origin. See Del Boca and Venturini (2003) and Bevilacqua et al. (2001).

of public schools and the enrollment rate of evening classes (public primary school was entirely attended by children while evening schools were mainly attended by adults). More important: following the literature on brain drain quoted above, we argue that the agent's conjecture to emigrate in the future relies on what he or she observes (and has observed), i.e. the present (and past) outflows.

As far as the second channel is concerned, it hides at least two mechanisms. The first relies on the returnees that are richer than they were at the time they left: thanks to accumulated savings they can afford the cost of sending children to school. The second is based on the 'awareness' rationale (Coletti, 1911) that induce returnees to send their children at school. We will not try to disentangle the two mechanisms in our empirical model.

3.2 Italy's education system (1860-1911)

Analysing the structure and the working of Italy's education system is a necessary step in our investigation. Very recently the topic have been deeply studied (Bertola and Sestito, 2011, 2013).

The first law issued in the new Kingdom of Italy (founded in 1861), the Casati Law, was issued in November 1859. It was inspired by the German system of nationally directed education and shaped Italy's education system up to 1877 (Zamagni, 2002; Bertola and Sestito, 2013). The law envisioned for free and compulsory primary school (for children from 6 years old) which was made up in two grades (high and low) each lasting two years. Funding of primary education was left to municipalities and the obligation to establish the high grade was limited to municipalities with over 4,000 inhabitants. De facto, only the low grade was mandatory. Privately organized establishments would be allowed to coexist with public ones, but all would have been subject to a common regulatory framework. Matteucci (1867) illustrated that the claim of a national mandatory school ended up in an unavoidable failure because the Italian liberal State exempted from providing constructions and teachers remuneration by shifting both charges to cities without making sure of their disposable funds (Genovesi, 2010; Vecchi, 2011).

In 1877 the Coppino Law extended compulsory schooling from two to three years and introduced a 5-year primary school curriculum, with provisions for enforcement and fines for non-compliant parents (Bertola and Sestito, 2013). Buonazia (1873) highlighted both delays on the supply side of the education system and insufficient demand for schooling by households.[11] The investigation thus showed that primary school was still heavily dependent from income (this is one of our key indentifying assumption on which our instrumental variable exercise presented in paragraph 4.2 is based). The situation turned up in huge disparities in primary education performances and even in the quality of teaching throughout the country.[12] Therefore, in the first decades after Unification the

[11] In northern Italy, in rural areas, there was a widespread practice of dropping out of school because of the use of children in farming and textile industries (Vecchi, 2011). Between 1870 and 1900, in Piedmont, at the beginning of the harvest season, schools were deserted. In Liguria there was no reluctance of farmers to the school, rather, as Cipolla (1969) stresses, it is the school that does not fit the needs of rural life.

[12] The quality of education does not depend only on the number of teachers and on the percentage of population attending school but also on what is taught and on the effectiveness of teaching as well

strong dependence of primary school on local resources crystallized the huge territorial differencies inherited from the pre-unitary period (Bertola and Sestito, 2013, p. 252).

Between November 1903 and March 1914, part of the period known as *Giolittian Age*, the political climate shifted in more progressive directions. In 1904, the Orlando law extended compulsory education to twelve years, reduced the primary school curriculum to four years and contemporaneously established the two-year professional training course (fifth and sixth grade). Actually, mandatory education could be accomplished by successfully completing the four-year program. The law also envisioned for the establishment of the evening classes for illiterate adults and in 1906 in the South was set up the *"Commissione Centrale per il Mezzogiorno"* to put up a fight against illiteracy. The ministerial inquiry carried out by Corradini (1909)[13] showed that the main problem of primary education system was the unsatisfactory actions realized by municipalities due to the lack of local resources (Cives, 1990; Vecchi, 2011). The final judgment on the reforms implemented is clear: they had little or no effects on the attendance rate of primary school (still, in the econometric exercise that will follow, we add controls for the possible effects of reforms).

The Corradini report significantly influenced the 1911 Daneo-Credaro law which finally bore the cost of all personnel and materials for primary education to the central State budget, *"leaving local governments in charge only of providing adequate buildings"*[14].This choice marked a substantial step forward in the fight against illiteracy (Genovesi, 2010; Felice, 2011)

3.3 A new dataset on Italian cities

Core to our analysis is the *Annuario Statistico delle Città Italiane* from 1906 to 1914, published every two years by the *Unione Statistica delle Città Italiane* and inspired by the *Annuario delle Città Tedesche*.[15] The *Annuario* collects records on the social, political and economical life of the largest municipalities (with more than 10,000 inhabitants) by breaking down data in the following categories: territory and population, education, hygiene and health, industry and employment. As argued by Niccolini (1906)[16] the choice to sample more important municipalities was taken to guarantee the comparability among the Italian cities and then minimize measurement errors as well as to tackle funds

(Cipolla, 1969). Because of their very low salaries, teachers were culturally and technically inadequate. In 1897, 4,009 teachers out of 17,940 did not have the legal authorization, many of them worked as tailors, sacristans and bell-ringers. In such an enviroment pupils dropped out of school, attended it listlessly or with great difficulty, anyway without being able to draw large payoffs from attending classes (see Genovesi (2010) for a detailed analysis on the economic conditions of teachers).

[13]Camillo Corradini (1867-1928) was an Italian politician.

[14]Actually Genovesi (2010) argues that the Daneo-Credaro law was not applicable to the provincial and district capitals. Therefore these cities continued to hold up the primary education costs, even after 1911. We note that our sample records statistics only on these municipalities.

[15]The 1912 *Annuario* is the only exception. It reports statistics on 1909. Unfortunately 1909 data on education are not so detailed as previously collected and therefore they are useless to our goal. Notice also that the Annuari contain data referring to two years before; so that the Annuario published in 1906 reports 1904 figures and so on.

[16]See the *Annuario Statistico delle Città Italiane 1906*

shortage.[17]

The section "Public Education" includes information on the number of schools (public, private and evening classes), number of teachers and pupils as well as on attendance and learning results. Data on public spending on education are available too. The chapters "Taxes" and "Main Consumptions" contain, instead, details on council public finance and data on consumptions (in kilograms) carefully divided into many product groups from fish to coffee, from meat to beer. Current prices of goods are also reported. Most relevant for this study is that available information allows us to measure abroad migration outflows (inflows) from (to) each municipality collected in the *Annuario*. Record keeping, however, became less detailed from 1914 onwards, then inadequate for our purpose: it contains only the net migration rate with no disentanglement between migration and returns.

Since our thesis is that in-and out-migration was correlated with higher levels of education, to begin with we present some wide empirical evidence on migration and schooling patterns from our municipalities dataset.
Figure 2 illustrates the cities distribution throughout Italy and shows that the municipalities in the sample are almost uniformly spread across national territory: out of roughly 110 cities detected, 47 belong to the South and 63 to the North. Hence a potential distorsion stemming from an over-represented area is avoided. Figure 3 shows the relationship between leavers (returns) and educated population at the city level. Correlation coefficients are all positive and statistically significant (except for Figure 3.c) at the 5 percent level.

Descriptive statistics are reported in Table 1. The values for *Attendance rate* are the percentage of pupils (of those enrolled) who did not drop out primary school. On average this attendance rate is about 81 percent but it results from the significant heterogeneity between the municipalities situated in the South (76.3 percent) and those in the North (83.7 percent). *Migration* and *Returns* represent the abroad outflows and from-abroad inflows respectively, obtained by dividing the flows by the municipality population and then multiplied by 1000. Both Table 1 and Figure 3 highlight the preponderance of returns in the North with respect to the South and show that Southerners were much more likely to leave than Northerners.

The attendance rate depends definitely on disposable income. At the city level yearly estimates of disposable income do not exist. Following Ciccarelli and De Fraja (2012),Becker and Woessmann (2009) and Mortara (1913), we proxy income with a measure of tax proceeds. We choose as our best proxy the sum of the tax revenues accruing from a large variety of council taxes. Specifically the categories are: family tax; local property and business taxes; taxes on boats, cars and velocipedes; servant tax; livestock and pet tax; hotel patent tax end tax on sparkling water production.[18] This wide range of taxes allows us to overcome two problems: the first is to avoid a possible

[17]Ippolito Niccolini (1848-1919) was an Italian politician and mayor of Florence from 1904 to 1907. He was chairman of the *Unione Statistica delle Città Italiane* from 1905 to 1907. In the first decade of the twentieth century, in Italy, the municipalities with more than 10,000 inhabitants were about 500, but among them only 20 percent responded to the questionnaires sent by the *Unione*. Furthermore, Ugo Giusti (already mentioned Italian statistician) points out that small municipalities (which have high heterogeneity) should be kept out from the survey in order to guarantee data compatibility.

[18]For more details see the *Annuario Statistico delle CittàItaliane*, from 1906 to 1914 and Villani (2011).

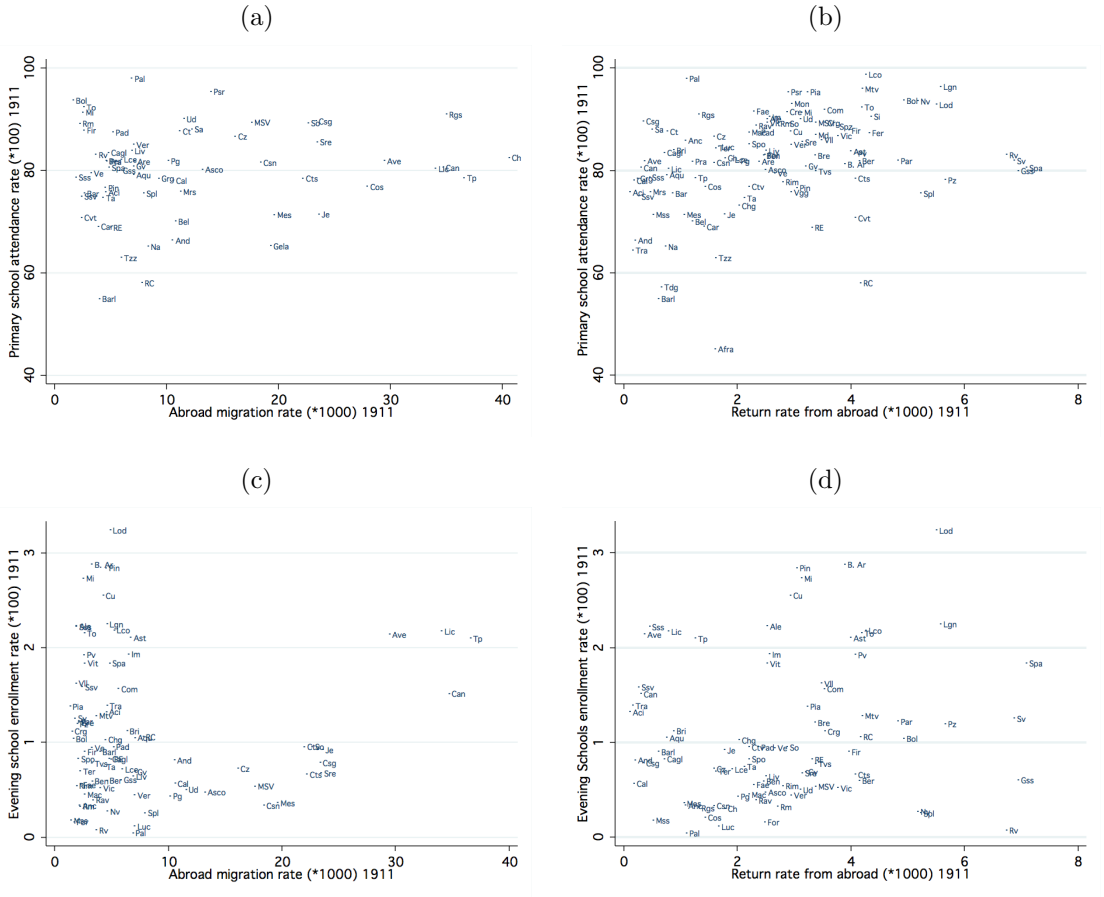
Figure 2: The distribution of the sampled cities on Italian Territory.

Source: Annuario Statistico delle Città Italiane

skewness in the distribution of taxpayers going from the wealthiest households to the poorest ones so that we have a relative broad and representative basis; the second is that we do not need to account for special circumstances affecting only some municipalities, for example by distinguishing those with the city gates or as Ciccarelli and De Fraja (2012) suggest, those that had a major ports.

The correlation coefficient between per capita GDP, as estimated in Baffigi (2011), and our measure of per capita tax proceeds is 0.98, statistically significant at the 5 percent level. *Expenditure* is the variable that proxies the education supply-side: it is the per capita public spending in primary education at the municipality level. By including this variable in equation 1 we catch the effect of different education policy decisions made by municipalities. Finally, *Remittances* is a rough proxy. It is the ratio between consumption tax proceeds and income tax proceeds, with the idea that an important part of not officially traced remittances is used for consumption although does not appear in official income.

Figure 3: The Cross-City Patterns of Migration and Education, 1911.



Source: see text.

4 Identification strategy and empirical findings

The three pillars of information just described (qualitative evidences, the primary education system and the new dataset) guide our identification strategy. The empirical model of endogenous schooling formation we estimate is the following:

$$y_{i,t} = \alpha + \beta_1 y_{i,t-1} + \beta_2 m_{i,t} + \beta_3 ret_{i,t} + \beta_4 exp_{i,t} + \beta_5 tax_{i,t} + \upsilon_{i,t} \quad (1)$$

where $y_{i,t}$ is alternatively the (log of) public primary school attendance rate or the evening school enrollment rate;[19] in year t, $t = 1904, 1906, 1908, 1911$ in the city i,$i = 1, \ldots, 87$; $m_{i,t}$ and $ret_{i,t}$ are the logs of abroad migration rate and return migration rate, respectively, in year t in the city i; $exp_{i,t}$ is the log of the per capita public expenditure on primary education, measured in current lire; $tax_{i,t}$ is the log of the per capita proxy of income in year t in the city i. It is worth to note that using the attendance rate rather than the enrollment rate (in the case of public education) allows us to overcome some problems: a) higher enrollment rate does not imply higher attendance rates; b) the use of enrollment

[19]When the dependent variable is 'evening enrollment rates, the variable *exp* is dropped out since it only refers to public primary schools.

Table 1: Descriptive statistics, 1904-1911[a]

	Variable	Mean	Std. Dev.	Min	Max
Sample	Attendance rate[b]	81.4	9.04	45.2	98.8
	Enrollment rate of evening schools[c]	9.37	7.39	0.00	35.3
	Literacy rate[d]	75.8	19.7	22.0	100
	Migration[e]	6.87	4.10	0.29	40.6
	Returns[f]	2.65	1.63	0.11	7.54
	Expenditure[g]	3.89	2.16	0.93	17.7
	Council taxes[h]	2.21	1.11	0.10	20.5
	Remittances[i]	13.6	8.20	0.30	41.5
	Transport Costs[l]	186.7	34.3	157	227.2
South	Attendance rate	76.3	10.5	45.2	98.0
	Enrollment rate of evening schools	7.34	5.65	0.00	22.2
	Literacy rate	53.8	13.6	22.0	90.4
	Migration	11.2	9.50	0.29	40.6
	Returns	1.23	1.07	0.11	5.66
	Expenditure	2.60	1.20	0.93	7.30
	Council taxes	2.14	0.59	0.10	4.65
	Remittances	19.4	7.98	0.83	41.5
	Transport Costs	185.0	36.3	157	216.3
North	Attendance rate	83.7	7.10	57.2	98.8
	Enrollment rate of evening schools	10.2	7.86	0.00	35.3
	Literacy rate	85.7	12.8	43.7	100
	Migration	4.82	4.26	1.01	25.0
	Returns	3.31	1.41	0.52	7.54
	Expenditure	4.48	2.26	1.18	17.8
	Council taxes	2.24	1.29	0.86	20.4
	Remittances	11.7	8.14	0.30	38.7
	Transport Costs	187.4	34.9	157	227.2

[a]Descriptive statistics on municipalities are based on annual data relative to 84 cities for the years 1904, 1906, 1908 and 1911. Total number of observations is thus equal to 337. We split the sample into the cities belonging to the South and the North as well. [b]attendance rate in public primary school; [c]enrollment rate in evening classes; [d]literacy rate; [e]abroad migration rate; [f]return migration rate; [h]per-capita public expenditure on primary education; [i]per-capita council taxes; [h]per-capita remittances; [l]transportation costs. Source: see text

rate tends to bias upward the education level of a given population. Cipolla (1969) and Vecchi (2011) suggest that the attendance rate is the best indicator to investigate the literacy rate of Italian population.

The lagged dependent variable in the right-hand side of equation (1) tries to control for the following two issues:

- *The urbanization process.* It is likely that large cities were attractive poles rather than repulsive ones as population relocates over the national territory in search of the

best work opportunities (Accetturo et al., 2012); if so, the attendance rate could be altered abruptly if a large number of people and their families moved on to the nearest city from the countryside. Thus attendance rate would pick up effects that would have nothing to do with the abroad migration or return migration;

- *The natural dynamics of population.* As before, it is clear that the natural increase may be a common driver of both migration (Hatton and Williamson, 1998) and attendance rate: the larger the shock on newborns (with respect to deaths) the larger the probability that primary school dropouts will change in the future;

As in Arellano and Bond (1991), the error term $\upsilon_{i,t}$ is a two-way error-component:

$$\upsilon_{i,t} = \lambda_t + \eta_i + \varepsilon_{i,t} \qquad i = 1, \ldots, I \qquad t = 1, \ldots, T \tag{2}$$

In (2), λ_t represents the municipality-invariant time-specific effect, η_i represents the time-invariant municipality-specific effects and $\varepsilon_{i,t}$ is a white noise, normally and independently distribuited across cities and periods.

Hence, the proposed formulation in equation (1) has the substantial advantage of reducing the burden of omitted variables by including the dependent lagged variable as explanatory one as well as time and cities' fixed effects. In this way, the coefficients of $m_{i,t}$ and $ret_{i,t}$ is more likely to capture the vigor of transmission channels we are interested in.

To investigate the idea that sees emigration and returns as drivers of schooling in Italy in the age of mass migration, we split this section into three parts: in the first part we test the relationship in the simplest possible way, namely, by testing a model with abroad outflows and from abroad inflows, as the only regressors (dummies are included). Then we try to deal with potential endogeneity issues between emigration and attendance. In the second part we adopt an instrumental variable (IV) approach while in the third part we estimate equation 1 in a multivariate framework using a GMM technique.

4.1 Migration and schooling: basic formulation.

The basic equations that we use in order to gauge our 'incentive channels', are the following:

$$y_{i,t} = \alpha_{0,i} + \alpha_1 m_{i,t} + \phi_1 \lambda_t + \varepsilon_{i,t} \tag{3}$$

$$y_{i,t} = \beta_{0,i} + \beta_1 ret_{i,t} + \delta_1 \lambda_t + \varepsilon_{i,t} \tag{4}$$

where λ_t is a set of time dummy variables capturing shocks common to all cities (for instance the influence of educational reforms), while cities' fixed effects catch unobservable time-invariant heterogeneity across municipalities.

The first column of table 2 gives evidence of a positive relationship between the abroad emigration rate and the attendance rate of public primary schools. A significant association between return migration and schooling comes to light as well. The coefficient of 0.019 (0.037) tells us that a 10 log point increase in the outflows (inflows) is associated with a 0.19 (0.37) log point increase in the attendance rate.

To control for the possibility that results are biased by geographical differences at higher level of aggregation than the city level, column (2) adds a complete set of

interaction terms between geographical dummy variables at macro-area level and time dummy variables. More precisely we classify our cities as belonging to the North-West, the North-Est, the Center and to the South and we make time dummies interact with geographical ones. To the extent that there is unobserved macro-regional time-variant heterogeneity, these interaction dummies should be able to capture most of its essence. Hence, the equations we estimate are the following:

$$y_{i,t} = \alpha_{0,i} + \alpha_1 m_{i,t} + \phi_1 \lambda_t + \phi_2(\lambda_t * \vartheta_{macro-areas}) + \varepsilon_{i,t} \tag{5}$$

$$y_{i,t} = \beta_{0,i} + \beta_1 ret_{i,t} + \delta_1 \lambda_t + \delta_2(\lambda_t * \vartheta_{macro-areas}) + \varepsilon_{i,t} \tag{6}$$

The estimated association between in-and out-migration and schooling remains robust.

Column (3) of table 2 shows the robustness of the relationship between migration and the attendance rate for a specification where outflows and inflows are jointly plugged into the same model: the coefficients are rather stable.

Table 3 -columns (1), (2) and (3)- reports the results obtained using the evening school enrollment rate as dependent variable. As in table 2, the results are quite robust across different specifications although the values of the elasticities tends to be much higher both for out-migration and for returns. The elesticity of enrollment rate with respect to emigration (returns) is 0.161 (0.300). This may provide some weak evidence for the view that migration would have spurred adults education. In section 5 we will resume this point related to the values of the elasticities.

Several worries may emerge in evaluating the association between emigration and schooling in a causal sense where endogeneity is not properly considered. This can be due to a two-way relationship between the dependent and independent variables, to possible omitted variables or measurement errors. In particular, migration is likely to be one of the causes for people to go to school but at the same time the probability of migration depends on the achievement of a given educational requirement, at least for adults; that is migrants are not randomly selected from the population of native countries [20].

Can the enormous number of migrants leaving Italy in the early twentieth century be viewed as exogenous with respect to the level of education attained? Williamson (2006) compares literacy rates for five European countries (France, Britain, Italy, Spain and Portugal) among adult immigrants to the United States between 1899 and 1909 to the literacy rates of the adults at home in 1901 (those who stayed). He finds that literacy rates among immigrants were on average higher with respect to source population, implying a positive selection.[21] In this respect, Italy could be an exception. The observed

[20] Under perfect positive selection the most educated individuals will emigrate with probability one (zero probability of leaving for the less able ones) and a brain gain would be impossible because, in this case, all the people that invest in schooling will leave. Hence a necessary condition for a brain gain is that the less educated persons have a positive (but lower than 1) probability of emigration (Docquier and Rapoport, 2009; Beine et al., 2011). Williamson (2006) gives an interesting piece of evidence supporting selective migration using Swedish clergymen evaluations of the intellectual abilities of their parishioners. From reverends' testimonies emerge that by comparing people who subsequently emigrated with those who remained, the former *"had a higher intellectual level, did better at school, and had a wider view of the world"*.

[21] Williamson (2006) argues that a positive selection was inevitable. Immigrant were younger than

Table 2: Public primary schools: the impact of migration and returns on the attendance rate at the city level,1904-1911.

	(1)		(2)		(3)	(4)
Dependent variable: log of the attendance rate	FE	FE	FE	FE	FE	IV
Migration$_t$	0.019**		0.020**		0.020**	0.027**
	(2.16)		(2.07)		(2.36)	(2.26)
Returns$_t$		0.037**		0.035**	0.035**	0.040**
		(2.30)		(2.11)	(2.13)	(2.15)
Fixed effect city	yes	yes	yes	yes	yes	yes
Fixed effect year	yes	yes	yes	yes	yes	yes
9 interaction terms (year*macro-regions)			yes	yes	yes	yes
R-squared	0.157	0.167	0.200	0.206	0.219	0.222
Observations	337	337	337	337	337	318
First stage						
Log of instrument						-1.089***
						(-6.87)
F-statistics						47.2
Testing Endogeneity						
Estimated coeff. on the residuals						0.010**
						(2.01)

Numbers in parentheses denote heteroskedasticity-robust t-statistics *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at the city level. Migration is instrumented in column IV. The control function approach is used to test the endogeneity of migration.

Table 3: Evening classes: the impact of migration and returns on the enrollment rate at the city level, 1904-1911.

	(1)		(2)		(3)	(4)
Dependent variable: log of enrollment rate	FE	FE	FE	FE	FE	IV
Migration$_t$	0.162*		0.149*		0.161*	0.248**
	(1.90)		(1.77)		(1.73)	(1.83)
Returns$_t$		0.261*		0.286**	0.300**	0.310*
		(1.87)		(2.04)	(2.15)	(1.75)
Fixed effect city	yes	yes	yes	yes	yes	yes
Fixed effect year	yes	yes	yes	yes	yes	yes
9 interaction terms (year*macro-regions)			yes	yes	yes	yes
R-squared	0.123	0.132	0.182	0.195	0.206	0.288
Observations	296	296	296	296	296	296
First stage						
Log of instrument						-1.04***
						(-5.81)
F-statistics						33.73
Testing Endogeneity						
Estimated coeff. on the residuals						0.120**
						(2.37)

Numbers in parentheses denote heteroskedasticity-robust t-statistics *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at the city level. Migration is instrumented in column IV. The control function approach is used to test the endogeneity of migration.

lower literacy rate among Italian emigrants relative to the Italian population reflects the dominance of poor southern Italians in the immigrant inflow. Still, the selection process must be evaluated on a strictly local basis: the emigrants from the South of Italy could be not less educated than their 'neighbors'. Furthermore, the seemingly negative selection among Italian emigrants, measured in terms of education and literacy, does not imply the absence of a selection based on unobservable (best and brightest characteristics). Gomellini and Ó Gráda (2013) suggest that in the past the presence of selection bias is clear: emigrants tended to be disproportionately young and healthy and the authors give also some clues about positive selection showing two indicators that militate (non conclusively) in favor of this thesis.

The other source of potential endogeneity that challenges our attempt of measuring the casual relationship between migration and schooling may arise from unobserved variables that affect both the independent variable and its covariates. The main candidate is obviously income. In poor families, very often economic conditions forced the head of household to leave in order to look for best opportunities abroad; at the same time this could increase the school drop out rate because of child were required to work in place of their fathers[22].

In the next paragraphs we try to give an answer to this potential sources of endogeneity, first by recurring to Instrumental Variables (IV) technique; second, by estimating a multivariate model with a GMM technique.

4.2 IVs and multivariate Model

To deal with potential concerns about reverse causality, omitted variables and, potentially, measurement error biases, we first make use of instrumental variable approach. We resort to a Two-Stage-Least-Squares (2SLS) strategy using the shipping lines' transportation costs. For each city i and for each year t we compute our instrument, $C_{i,t}$, as described by equation 7:

$$C_{i,t} = tc_{i,k} + sc_{k,t} \tag{7}$$

where $tc_{i,k}$ is the average cost of a third class rail travel from city i to the nearest embarkation port k and $sc_{k,t}$ is the averaged steerage cost from port k to the destination countries (Argentina, Brazil and the U.S.). Thus, $C_{i,t}$ have a straightforward interpretation: it is the amount of money the potential migrant needed to reach America from the municipality of residence.[23]

To construct the instrument we have collected data from several sources. First, from

the source adults population and, as there was a schooling revolution taking place in late nineteenth century in Europe (Cipolla, 1969), literacy soared among the young movers compared with the old stayers. Moreover he adds that while there was certainly some positive screening, it probably did not translate into a big brain drains from Europe.

[22]This is the main mechanism that could affect the relationship between migration and schooling in a negative way. Contrary, as argued by Cipolla (1969), literacy could be triggered off by poverty which pushes individuals to emigrate to search for a job and simultaneously forces them to learn letters to keep in touch with relatives or to take advantage from their knowledge as traveling teachers.

[23]Although it is very likely that the potential migrant reached the port of embarkation on foot, we are assuming that she took the train. Ours is an attempt to quantify the cost of travelling to the ports.

the *Annuario Statistico Italiano* we have obtained the cost of ticket to travel from each city in our sample to the nearest port of embarkation; by law emigrants were limited to departure from the ports of Genoa, Naples and Palermo.[24] Second, we follow Cannon (2010) to calculate the steerage rates. The *Annuario Statistico della Migrazione Italiana dal 1876 al 1925* lists the annual price of steerage fares for the period 1902-1925 for all navigation lines to the U.S., Brazil and Argentina. We cross-checked the steerage data with records from the *Movimento della Navigazione nei Porti del Regno* for the period 1902-1911. From the ports of Genoa, Naples and Palermo many European and American shipping companies offered regular service to the U.S. (Boston, Philadelphia and New York), Brazil and Argentina including the three major Italian lines: Lloyd Italiano, La Veloce and Navigazione Generale Italiana. We averaged the annual steerage prices to reach the destination countries for the years 1904,1906,1908 and 1911.

The validity of this instrument requires that it must be uncorrelated with the dependent variable (school attendance rate in 1904-1911), other than through its relation with the independent variable (i.e, city emigration at time t). Specifically, to solve the identification problem, $C_{i,t}$ must satisfy two conditions. First, it must be exogenous in equation 5. We believe this assumption is likely to be met, since it is implausible that the transportation costs could have affected intra-city schooling choices or these costs was affected by unobserved factors at the city level. Second, it must be partially correlated with emigration at time t, once the other exogenous variables have been netted out. The literature on migration agrees that transportation costs were an important determinant of emigration. At the turn of the XIX century there was a dramatic decline in freight shipping which could have impacted migrant flows. During the peak period of Italian emigration in the early XX century there is evidence of a significant (negative) correlation between the fluctuations in steerage fares and the rate of emigration to America at least until 1910 when the cartel agreement of 1909 between shipping companies began to take effect. Deltas et al. (2008) show that shipping cartels tend to reduce passengers flows by 20 to 25 percent. Then, we use $C_{i,t}$ as an exogenous variation to predict migration at the city level.

Column (4) of Table 2 reports the IV estimate of the effect of abroad migration (and returns) on schooling, where migration is instrumented in the way just described.[25] The positive effect of outflows (and of returns) on schooling is highly robust across the models. The point estimates go from 0.020 in FE specification, to 0.027 in IV model. Column (4) of Table 3 reports the IV estimate of the effect of abroad migration (and returns) on evening school enrollment rates. Estimated coefficients double in IV specification (from 0.161 to 0.348) while the coefficients on returns remain steady around 0.3. Our results present a number of common features. First, the instrument is very strong: the first stage F-statistics is 41.2 in Table 2 and 23.9 in Table 3. According to the thresholds

[24] Only a tiny share of emigrants departed from Messina.

[25] In columns (4) we treat returns as exogenous, since the hypothesis of a two-way relationship between return and schooling is it is quiet implausible. For example it is difficult to argue that the improvement of the education system in Italy in the period 1904-1911 encouraged migrants to return; ministerial inquiries about the condition of the Italian school system contradict this thesis. Likewise, the hypothesis that the dynamics of the Italian income attracted migrants is quite questionable. For more details on the causes of return migration see Cerase (1967).

of Stock and Yogo (2005), we can assured that weak instruments issues do not apply. Second, the IV estimate generates an upward correction in the coefficients with respect to LS estimates. This possibly stems from measurement error bias and from the negative relationship between migration and income (omitted variable) that produce downward biased estimates.

As a further check on our choice to resort to an IV procedure to estimate the effect of migration on education, the control function approach can help us to determine whether or not migration suffers from endogeneity.[26] This approach requires to take the estimated residuals of the first stage regression and plug them into the equation 5 as an explanatory variable. The inclusion of this error term "controls" for the endogeneity of $m_{i,t}$. Specifically, if the coefficient on the residuals is not statistically significant, that is the null-hypothesis is not rejected, then $m_{i,t}$ is exogenous in equation 5 and as a consequence we do not need IV; if residuals enter significantly, there is evidence that migration is endogenous and the IV method is inevitable.
The last rows in Table 2 and in Table 3 present the results of this exercise for the attendance rate in the public primary schools and for the enrollment rate in the evening classes respectively. In both cases the coefficient on the residuals is statistically different from zero, suggesting endogeneity and then it is correct to run IV regressions as we did.

Last, we move to the multivariate version of the empirical model proposed in equation 1. The GMM estimation procedure is required to face the dynamic panel structure of the model. Table 4 reports our results; each column shows the results of an alternative specification for the estimation of equation 1. The third and the fourth columns are our benchmark specifications. We estimate equation 1 by using the difference GMM method (GMM-dif). Namely, we use both one-step and two-step GMM-dif estimators (column headed GMM1 and GMM2 respectively).[27] The instruments proliferation (over-identification) and overfitting are the main drawbacks of GMM methods. S-test of Sargan (1958, 1988) and J-test of Hansen (1958) provide guidance on possible excess of instruments.[28] We use this approach in the following analysis.

[26] See Wooldridge (2010) for further details on the control function approach to endogeneity.

[27] GMM-dif (Holtz-Eakin et al., 1988; Arellano and Bond, 1991) treats the model as a system of equations, one for each time period. The equations differ only in their moment condition sets. The predetermined and endogenous variables in first-difference are instrumented with suitable lags of their own levels. Strictly exogenous regressors enter the instrument matrix in first differences, with one column per instrument. Compared to GMM-dif, the Anderson and Hsiao (1982) estimator (IV2SLS in table 4) is consistent but it is not efficient because it does not exploit all the moment conditions and its instrument matrix; it uses the second lag of the dependent variable as instrument for its first differences. We have one and two-step variants with two-step estimates asymptotically more efficient, although simulation studies suggest very modest efficiency gains from two-step, even in presence of heteroskedasticity (Blundell et al., 2000). In two-step GMM estimator there is an extra variation because the optimal weight matrix depends on estimated parameters. Asympototic standard errors do not take into account of this extra variation in small sample; as a result inference in small sample is unreliable. Thus the two-step asymptotic standard errors are too small and t-statistics too big; in other words there is an overfitting bias in small sample (this extra variation is negligible in large sample). In this sense the t-tests based on the one-step procedure are more accurate. Anyway, Windmeijer (2005) provides corrected standard errors and t-tests that are reliable as those based on the one step GMM estimator.

[28] S-test of Sargan (1958, 1988) in the homoskedastic case and J-test of Hansen (1958) in the heteroskedastic case test the validity of the instruments set. The statistics is distributed as a chi-square with degree of freedom equal to the number of moment conditions. Under the null over-identification

Table 4: The impact of migration on the attendance rate: multivariate model (public primary schools), 1904-1911.

Dep. variable: log of the attendance rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	FE	IV2SLS	GMM1	GMM2	GMM1	GMM2	GMM1	GMM2
Attendance_{t-1}	-0.271***	-0.536	-0.49**	-0.48**	-0.44**	-0.51***	-0.524***	-0.61***
	(-4.16)	(-1.53)	(-2.82)	(-2.40)	(-2.18)	(-3.45)	(-2.66)	(-3.14)
Migration_t	0.021**	0.040	0.024**	0.032***	0.023**	0.030***		
	(2.32)	(1.61)	(1.92)	(2.73)	(2.27)	(2.70)		
Migration_{t-1}					-0.012	-0.013	-0.015	-0.132
					(-1.38)	(-1.45)	(-1.53)	(-1.06)
Returns_t	0.089*	0.163**	0.046*	0.050**	0.042*	0.047**	0.043*	0.060**
	(1.75)	(2.28)	(1.90)	(2.30)	(1.79)	(2.07)	(1.80)	(2.22)
Expenditure_t	-0.014	0.100	-0.020	0.005	-0.022	0.002	-0.017	-0.023
	(-0.42)	(0.73)	(-0.58)	(0.16)	(-0.66)	(0.01)	(-0.50)	(-0.72)
Council Taxes_t	-0.001	0.083	0.061***	0.057**	0.066**	0.067**	0.069**	0.076
	(-0.05)	(0.63)	(2.67)	(1.97)	(2.50)	(2.08)	(2.27)	(1.62)
Remittances_t	0.043*	0.029	0.048*	0.038*	0.041*	0.040**	0.047**	0.060**
	(1.79)	(0.48)	(1.85)	(1.84)	(1.87)	(1.96)	(2.08)	(2.32)
Fixed effects city	yes	yes	yes	yes	yes	yes	yes	yes
Fixed effects year	yes	yes	yes	yes	yes	yes	yes	yes
R-squared	0.302	0.008	0.390	0.377	0.285	0.263	0.215	0.263
J-statistic (p-value)	-	-	0.703	0.703	0.752	0.752	0.221	0.221
Observations	201	104	104	104	104	104	104	104

Numbers in parentheses denote values of heteroskedasticity-robust t-statistics. *** p<0.01, ** p<0.05, * p<0.1 Past values of attendance rate, migration, taxes and remittances used as instruments in column FE2SLS, and in whatever specification headed GMM1 or GMM2. $C_{i,t}$ as defined in equation 7 is used as instrument as well. We use the finite sample correction for the asymptotic variance of the two-step GMM estimator suggested by Windmeijer (2005). J-stat $\sim \chi^2_{13}$; p-value is reported. R^2 is computed as the squared correlation coefficient between actual and fitted values. Source: see text.

Table 5: The impact of migration on the enrollment rate; multivariate model (evening classes). , 1904-1911.

Dep. variable: log of enrollment rate	(1) FE	(2) IV2SLS	(3) GMM1	(4) GMM2	(5) GMM1	(6) GMM2	(7) GMM1	(8) GMM2
Enrollment rate$_{t-1}$	-0.067	0.020	0.124	0.143	0.077	0.096	0.084	0.167
	(-0.91)	(0.15)	(0.52)	(0.46)	(0.36)	(0.32)	(0.36)	(0.45)
Migration$_t$	0.167*	0.373	0.340*	0.300*	0.284**	0.255*		
	(1.72)	(1.06)	(1.82)	(1.68)	(1.97)	(1.71)		
Migration$_{t-1}$					-0.120	-0.095	-0.114	-0.060
					(-1.13)	(-0.75)	(-0.99)	(-0.37)
Returns$_t$	0.447	0.285	0.156	0.148	0.257	0.230	0.237	0.238
	(1.42)	(0.84)	(0.67)	(0.65)	(1.03)	(0.99)	(0.96)	(0.68)
Council Taxes$_t$	0.387**	0.485	0.622*	0.435**	0.577*	0.939**	0.549*	0.942**
	(2.30)	(1.83)*	(1.80)	(2.35)	(1.84)	(2.23)	(1.70)	(1.96)
Remittances$_t$	0.076	-0.103	-0.053	-0.092	-0.067	-0.086	-0.039	-0.011
	(0.88)	(-0.29)	(-0.34)	(-0.52)	(-0.43)	(-0.23)	(-0.26)	(-0.57)
Fixed effects city	yes	yes	yes	yes	yes	yes	yes	yes
Fixed effects year	yes	yes	yes	yes	yes	yes	yes	yes
R-squared	0.225	0.296	0.276	0.277	0.295	0.288	0.283	0.293
J-statistic (p-value)	-	-	0.261	0.261	0.254	0.254	0.222	0.222
Observations	207	85	85	85	85	85	85	85

Numbers in parentheses denote values of heteroskedasticity-robust t-statistics. *** p<0.01, ** p<0.05, * p<0.1 Past values of enrollment rate, migration, taxes and remittances used as instruments in column FE2SLS, and in whatever specification headed GMM1 or GMM2. $C_{i,t}$ as defined in equation 7 is used as instrument as well. We use the finite sample correction for the asymptotic variance of the two-step GMM estimator suggested by Windmeijer (2005). J-stat $\sim \chi^2_{12}$; p-value is reported. R^2 is computed as the squared correlation coefficient between actual and fitted values. Source: see text.

In Table 4, abroad migration and returnees contributions are statistically significant in most of the proposed specifications and the associated coefficients are in general robust. An increase in the outflows has a positive impact on attendance in primary schools; return migration effects match the qualitative literature claims. The magnitude of their elasticities ranges from 0.023 to 0.032 for migration and from 0.046 to 0.050 for returnees; similar results are found in other studies focused on present time (Beine et al., 2003; Docquier and Rapoport, 2009; Fratesi and Percoco, 2009).

The positive and significant coefficients on council taxes (our proxy for income) catch the relationship between education and income. In contrast, we fail to find any evidence on the contribution of per capita municipal expenditure. This result fits with different hypothesis: the ineffectiveness of expenditure, the lack of an adequate variable to proxy public policy or the correlation with income.

Many scholars have emphasized the influence of remittances on alleviating the budget constraint that prevents people to invest in education. We test this hypothesis in the last row of Table 4. If we believe the coefficients in regressions (3) and (4), then a 10 percent increase in the remittances is associated with a 0.48 and a 0.38 percent increase in the attendance rate.

In columns (5) and (6), equation 1 is modeled by introducing the log of the lagged abroad migration rate, while the columns (7) and (8) report the estimation of the model obtained by simply excluding current migration as regressor but keeping up lagged outflows. The lagged emigration rate is never significant even when we remove current emigration. This may be due to two reasons. The first is that the time span, between subsequent surveys in the panel we use, is large enough to allow the coefficient of $m_{i,t}$ to pick up past shocks on migration; the second is that the influence on schooling we have come to expect from lagged migration is gathered up by the $y_{i,t-1}$ coefficient. The latter hypothesis is plausible since in an unreported regression we estimate a model by excluding the lagged attendance rate. The abroad migration and the lagged abroad migration rate coefficients are both positive and significant.

In Table 5 we repeat the regressions of Table 4 for the enrollment rate in evening schools, that are attended mainly, if note exclusively, by adults. We drop out the variable *exp* since it only refers to public primary schools. Again, the connection between migration and enrollment rate in evening schools is much bigger than the connection between migration and the attendance rate in ordinary schools. A 10 percent increase in outflows leads to a 3 percent higher entry in evening classes. Income has the expected positive sign; in contrast the effect of remittances and the effect of returns are not statistically signicant.

Some theoretical studies on migration (Mountford, 1997; Beine et al., 2001) predict non linear effects of migration prospects on human capital formation and as a consequence on education. More precisely, these models suggest that a greater positive brain gain should be observed mostly in the poorest countries. The idea is that in such countries the motivation to invest in schooling are extremely low unless substantial external options are offered to potential migrants (Beine et al., 2001). As regards returns, historical

restrictions are valid. We fail to reject it (p-values are reported in the table 4) so our instruments set is valid. Note also that in the command *xtabond2*, used to carry out the estimations in Stata, the R-squared is not available. We compute it as the squared correlation coefficient between actual and fitted values.

economic literature offers us a plausible explanation for additional effects. Del Boca and Venturini (2003) argue that the various constraints to start-up new entreprises limited the development of the local economies. Specifically only in the North-East a positive influence ot returns seems to come out because return migration was encouraged and supported. In the South returning migrants faced severe difficulties in finding a job and in finding support for their investments. Cerase (1967) shows that people who returned were unable to implement their plans partly because of the hostility of the local bureaucracy. Coletti (1911) observes that in Friuli the savings accumulated abroad were used differently from the South: they were used to establish small businesses; moreover he predicts that if this practise had been possible in the *Mezzogiorno*, Italian migration would have been more successful for the whole country.

To deal with this issues we modified the equation as follows 1:

$$\begin{aligned} y_{i,t} = \alpha + \beta_1 y_{i,t-1} + \beta_2 m_{i,t} + \beta_3 ret_{i,t} + \beta_4 exp_{i,t} + \beta_5 tax_{i,t} + \\ + \beta_6 (m_{i,t} * South) + \beta_7 (ret_{i,t} * South) + \upsilon_{i,t} \end{aligned} \tag{8}$$

where *South* is a dummy variable which equals 1 if municipality belongs to the South and equals 0 otherwise. Under specification 8 the interaction terms give the differential effects at the South with respect to the North. According to the literature quoted above, the coefficient of $m_{i,t} * South$ should be positive and significant and the coefficient of $ret_{i,t} * South$ should be negative and significant. We report the results obtained in columns headed (1) in Table 6.

In contrast to Beine et al. (2001) and Coletti (1911) but accordingly to Beine et al. (2003) and Docquier and Rapoport (2009) the interaction coefficients display the expected signs but they are not statistically significant (Table 6, column 1). Therefore, conditionally to our sample, estimation suggests no evidence of non-linear effects of outflow and inflows on education: the South does not seem to get additional effects (this could be due to the effectiveness of fixed effect in removing cities' heterogeneity). The coefficients on migration and returns remain significantly positive and their values are quite similar to those on Table 4 in the columns (3) and (4); this confirms the robustness of the results obtained in the linear specifications.

Historical documents emphasize the importance of private schools and evening classes in educating adults especially in the largest cities (as those in our sample). Figures related to public schools are obviously not able to catch these possible channels.[29] In Table 6 we check the presence of non linearities by estimating the equation 8 also using the enrollment rate in evening schools as a dependent variable (column 2). As we already found in column (1), the elasticities on the interaction terms are not statistically different from zero. We take these results as a suggestion that, at least as far as the effects of retunees on evening schools are concerned, more investigation is needed.

Finally we used the literacy rate as dependent variable rather schooling rates. Literacy data, in the *Annuario Statistico delle Città Italiane*, derive from marriage registers. It is the share of brides and grooms who were able to sign their marriage certificates. Although

[29]For instance in 1906 in Turin, Milan, Rome and Naples there were 8,000; 11,000; 10,000 and 15,000 people enrolled in private schools respectively. Unfortunately the dataset does not report their age.

Table 6: Multivariate model, 1904-1911; Robustness Analysis.

Dependent variable:	Attendance rate (1)		Enrollment rate (2)		Literacy rate (3)	
	GMM1	GMM2	GMM1	GMM2	GMM1	GMM2
Attendance rate$_{t-1}$	-0.447**	-0.462***				
	(-2.49)	(-2.27)				
Enrollment rate$_{t-1}$			0.051	0.012		
			(0.20)	(0.03)		
Literacy rate$_{t-1}$					-0.264*	-0.259**
					(-1.70)	(-2.43)
Migration$_t$	0.020*	0.024**	0.321*	0.294*	0.020	0.011
	(1.75)	(2.03)	(1.66)	(1.70)	(0.98)	(0.55)
Returns$_t$	0.066*	0.056*	0.196	0.153	0.039	0.028
	(1.70)	(1.81)	(1.46)	(0.92)	(0.98)	(0.56)
Expenditure$_t$	-0.015	-0.021			0.048	0.047
	(-0.47)	(-0.63)			(0.93)	(0.81)
Council Taxes$_t$	0.049**	0.038*	0.546**	0.799*	-0.030	-0.027
	(2.16)	(1.64)	(2.15)	(1.81)	(-0.75)	(-0.04)
Remittances$_t$	0.050 **	0.052**	(-0.116)	(-0.027)	0.020	0.0244
	(2.16)	(1.97)	(-0.82)	(-0.14)	(1.08)	(1.01)
South*Migration$_t$	0.070	0.079	0.292	0.145		
	(1.49)	(1.54)	(0.93)	(0.13)		
South*Returns$_t$	-0.066	-0.078	-0.664	-0.820		
	(-1.07)	(-1.22)	(-1.02)	(-0.92)		
Fixed effects city	yes	yes	yes	yes	yes	yes
Fixed effects year	yes	yes	yes	yes	yes	yes
R-squared	0.277	0.243	0.330	0.352	0.088	0.073
J-statistic (p-value)	0.751	0.751	0.252	0.252	0.828	0.828
Observations	104	104	85	85	104	104

Numbers in parentheses denote values of heteroskedasticity-robust t-statistics. *** p<0.01, ** p<0.05, * p<0.1. Past values of attendance rate, migration, taxes and remittances used as instruments in whatever specification headed GMM1 or GMM2. $C_{i,t}$ as defined in equation 7 is used as instrument as well. We use the finite sample correction for the asymptotic variance of the two-step GMMestimator suggested by Windmeijer (2005). J-stat $\sim \chi^2_{11}$; p-value is reported. R^2 is computed as the squared correlation coefficient between actual and fitted values. Source: see text.

the magnitude of the *Migration* and *Returns* coefficients are quite similar to previous estimations and have the expected signs, they are not statistically significant (column 3). We explain this result by considering that literacy is a more general concept than dropout or attendance rates and it is a more comprehensive measure of accumulated human capital rather than schooling (Becker and Woessmann, 2009); as a consequence, it is very plausible that outflows and inflows are not able to catch up the whole phenomenon. Furthermore, as argued by Cipolla (1969) and Vecchi (2011) higher levels of attendance do not imply higher levels of literacy. In 1829, in Naples, out of 2,000 girls who regularly attended the school only a fifth actually learned to read. In 1870, in the province of Turin (the most developed in terms of literacy) education meant in being able to read just a little and write incorrectly; in fact after a few years that students have completed the school, many of these were no longer capable to understand what they read, nor to write their own name correctly.

5 Back of the envelope

A useful way to interpret the effect of migration on education is to translate the estimates we have got so far into numbers that express the magnitude of the incentive mechanisms.

We start with some stilized facts about migration and school attendance which are more likely to fit this kind of exercise. Overall, in our sample 72,015 people left in the years 1904, 1906, 1908, 1911 (18,003 per annum on average); whereas in the same time span 19,856 individuals returned (4,964 per annum). Therefore in our sample the proportion of returnees is a bit less than one third of those who left in the same period. As we have already noted, on average, the public primary school attendance rate is about 81 percent. Furthermore, in the years under analysis the number of students enrolled in schools are, on average, 495,940; therefore the stock of people that did not drop out is 401,710. The average flow of the new students is instead 49,162 of which 39,821 did not drop out.

What was the actual effect of the big surge of migrants on school attendance? In particular, how many people stayed at school and did not left their classrooms, because of migration? Next we will try to give a quantitative answers to these questions.
To this end we recall equation 1:

$$y_{i,t} = \alpha + \beta_1 y_{i,t-1} + \beta_2 m_{i,t} + \beta_3 ret_{i,t} + \beta_4 exp_{i,t} + \beta_5 tax_{i,t} + \upsilon_{i,t}$$

From the equation above we can calculate the implied long run elasticities of abroad emigration and return migration, i.e. the elasticities that would prevail in the long run, computed, supposing that the model is in a steady state equilibrium. We interpret the 1904-1911 elasticities as percentage changes in the attendance rate that would follow a permanent change in outflows and inflows so that $y_{i,t} = y_{i,t-1}$. Given the empirical model, this long run abroad emigration and return migration elasticities are respectively:

$$\frac{\beta_2}{1-\beta_1} \tag{9}$$

$$\frac{\beta_3}{1-\beta_1} \tag{10}$$

while β_2 and β_3 are the impact multipliers.
In the case of public primary schools the estimated elasticity of the *attendance rate* to *migration* ranges from 0.019 to 0.032 (Table 2 col. 1 and Table 4, col. 4). To this estimate corresponds a long run elasticity that goes from 0.013 to 0.022.[30] Similarly, the elasticity with with respect to *Returns* ranges from 0.035 to 0.060 (Table 2 col. 2 and Table 4, col. 8); the steady state elasticity ranges from 0.024 to 0.040.

By translating these figures in the number of people, we have that each 100 people who additionally left, kept at school a number of individuals going from 4 to 7 in the short term and a number ranged from 3 to 5 in the long run. Following the same line of reasoning, our results suggest that every 100 additional returnees, increased the number of non-dropping out pupils in a range from 8 to 11 as impact, and a number from 5 to 9 in the "steady state". For evening schools, the elasticity of the *enrollment rate* to *Migration* ranges from 0.16 to 0.348 (Table 3, col.1 and Table 3, col. 4) as impact and from 0.30 to 0.38 in steady state. The coefficients of *Returns* are not different from zero in the multivariate model: Table 5. Although elasticities are very high, we found "'reasonable"' magnitudes since evening enrollments are very little. So, according to our calculations, 100 more migrants pushed into evening schools from 11 to 14 individuals both as impact and in steady state. This is a reassuring upshot given that previous empirical studies on the brain gain are almost in line with these figures (e.g. Docquier and Rapoport, 2009).

6 Conclusions

The idea of a *brain gain* has been investigated by many scholars and it is well documented for Italy by historical qualitative evidences. This paper is a first attempt of measuring the effects of migration on schooling in Italy in the age of mass migration. More precisely, we investigated whether emigration, its prospects, and return migration raised school attendance rates in Italy in the first decade of the XX century. Results are obtained by using a unique dataset at the municipal level that allowed us to partially overcome some of the problems deriving from the lack of suitable data. We tried to detect causality going from migration to schooling, conditionally to our dataset and to the period of inspection. To do so, we estimated the effects of migration and return migration on the attendance rate controlling for fixed effects at the city level and using an IV strategy based on a measure of shipping lines' transportation costs as instrument for migration. We also resorted to a GMM estimation in a multivariate framework and tested its robusteness with respect to different aspects. Finally, we trasformed elasticities into people, i.e., we calculated the amount of individuals motivated not to leave schools because of migration .

The results empirically support the working of a brain gain fueled by outward migration and returns. According to our estimates, every 100 people who additionally left kept at

[30] We choose β_1= -0.48 deriving from col. 4 in Table 4.

school from 4 to 7 individuals. Return migration seems to have a stronger impact on primary schooling but does not seem to affect the education of the adults. We tested the effects of remittances (proxied by the unexplained variation in consumption) and we investigated possible residual heterogeneity at the macroarea level: no differences emerged between the North and the South. Coherently with many other studies, we can say that the traditional perception of the brain drain often labelled as a *looting* from poorer countries to richer ones, met some countervailing forces in the case of Italy at the beginning of Twentieth Century.

References

Accetturo, A., Manaresi, F., Mocetti, S., and Oliveri, E. (2012). Don't stand so close to me: The urban impact of immigration. Banca d'Italia - Temi di Discussione, no. 866.

Anderson, T. and Hsiao, C. (1982). Formulation and estimation of dynamic models using panel data. *Journal of Econometrics*, 18(1):47–82.

Arellano, M. and Bond, S. (1991). Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *Review of Economic Studies*, 58:277–297.

Baffigi, A. (2011). Italian national accounts, 1861-2011. In *Quaderni di Storia Economica*, number 18. Bank of Italy.

Bandiera, O., Rasul, I., and Viarengo, M. (2012). The making of modern america: Migratory flows in the age of mass migration. *Journal of Development Economics*. forthcoming.

Becker, S., Ichino, A., and Peri, G. (2004). How large is the brain drain from italy? *Giornale degli Economisti e Annali di Economia*, 63:1–32.

Becker, S. and Woessmann, L. (2009). Was weber wrong? a human capital theory of protestant economic history. *Quarterly Journal of Economics*, 124(2):531–596.

Beine, M., Defoort, C., and Docquier, F. (2011). Ia panel data analysis of the brain gain. *World Development*, 49(4):523–532.

Beine, M., Docquier, F., and Rapoport, H. (2001). Brain drain and economic growth: Theory and evidence. *Journal of Development Economics*, 64(1):275–289.

Beine, M., Docquier, F., and Rapoport, H. (2003). Brain drain and ldcs' growth: Winners and losers. IZA Discussion Papers no. 819.

Bertocchi, G. and Strozzi, C. (2008). International migration and the role of institutions. *Public Choice, Springer*, 137(1):81–102.

Bertola, G. and Sestito, P. (2011). A comparative perspetive on italy's human capital accumulation. In *Quaderni di Storia Economica*, number 6. Bank of Italy.

Bertola, G. and Sestito, P. (2013). Human capital. In Toniolo, G., editor, *The Oxford Handbook of The Italian Economy since Unification*. Oxford University Press, Oxford, New York.

Betran, C. and Pons, M. (2004). Skilled and unskilled wage differentials and economic integration, 1870-1930. *European Review of Economic History*, 8(1):29–60.

Bevilacqua, P., De Clementi, A., and E., F. (2001). *Storia dell' Emigrazione Italiana*, volume 2. Donzelli, Roma.

Bhagwati, J. and Hamada, K. (1974). The brain drain, international integration of markets for professionals and unemployment. *Journal of Development Economics*, 1(1):19–42.

Bhagwati, J. and Wilson, J. (1989). *Income Taxation and Internation Mobility*. M.I.T. Press, Cambridge.

Biondo, A., Monteleone, S., Skonieczny, G., and Torrisi, B. (2012). Propensity to return: Theory and evidence of italian brain drain. *Economic Letters*, 115:359–362.

Blundell, R., Bond, S., and Windmeijer, F. (2000). Estimation in dynamic panel data models: Improving on the performance of the standard gmm estimator. In Baltagi, G., editor, *Advances in Econometrics: Vol. 15 Non Stationary Panel, Panel Cointegration, and Dynamic Panels*. JAI Elsevier Science, Amsterdam.

Borjas, G. J. (1989). Immigrant and emigrant earnings: A longitudinal study. *Economic Inquiry*, 27:21–37.

Borjas, G. J. and Bratsberg, B. (1996). Who leaves? the outmigration of the foreign-born. *Review of Economics and Sastistics*, 78(1):165–176.

Buonazia, G. (1873). *Documenti sull' Istruzione Elementare nel Regno d'Italia*, volume III. Botta, Roma.

Cerase, F. (1967). Sulla tipologia di emigranti ritornati: il ritorno di investimento. *Studi Emigrazioni*, 10:327–349.

Ciccarelli, C. and De Fraja, G. (2012). The demand for tobacco in post-unification italy. CEPR, Discussion Papers, no. 9197.

Cipolla, C. (1969). *Litercy and Development in the West*. Il Mulino, Bologna.

Ciriaci, D. (2005). La fuga del capitale umano dal mezzogiorno: Un catching-up sempre più difficile. *Rivista Economica del Mezzogiorno*, (2):369–403.

Cives, G. (1990). *La Scuola Italiana dall'Unità ai Nostri Giorni*. La Nuova Italia, Firenze.

Coletti, F. (1911). Dell'emigrazione italiana. In Accademia dei Lincei, R., editor, *Cinquanta Anni di Storia Italiana*, volume III. Hoepli, Milano.

Commissariato Generale dell' Emigrazione (1927). *Annuario Statistico della Emigrazione Italiana dal 1876 al 1925*. Commissariato Generale dell'Emigrazione, Roma.

Corradini, C. (1909). L'istruzione primaria e popolare in italia con speciale riguardo all' anno scolastico 1907-1908. Ministry of Education.

Del Boca, D. and Venturini, A. (2003). Italian migration. IZA Discussion Papers no. 938.

Deltas, G., Sicotte, R., and Tomczak, P. (2008). Passenger shipping cartels and their effect on trans-atlantic migration. *Review of Economics and Statistics, no. 90*.

Docquier, F. and Rapoport, H. (2003). Ethnic discrimination and the migration of skilled labor. *Journal of Development Economics*, 70:159–172.

Docquier, F. and Rapoport, H. (2009). Quantifying the impact of highly-skilled emigration on developing countries. Mimeo, CEPR project, Fondazione Rodolfo Debenedetti.

Dustmann, C., Fadlon, I., and Weiss, Y. (2011). Return migration, human capital accumulation and the brain brain. *Journal of Development Economics*, 95(1):58–67.

Dustmann, C. and Weiss, Y. (2007). Return migration: Theory and empirical evidence from uk. *British Journal of Industrial Relations*, 45:236–256.

Egger, H. and Felbermayr, G. (2009). Endogenous skill formation and the source country effects of emigration. *Journal of Economics and Statistics*, 229(6):706–729.

Einaudi, L. (2007). *Le Politiche dell'Immigrazione in Italia dall'Unità ad Oggi*. Laterza, Roma.

Felice, E. ((2011)). The determinants of italy's regional inbalances over the long run: Exploring the contributions of human and social capital. Oxford University - Discussion Papers in Economic and Social History, no. 88.

Fenoaltea, S. (2002). Production and consumption in post-unification italy; new evidence, new conjectures. In *Quaderni dell' Ufficio Ricerche Storiche*, number 5. Bank of Italy.

Fratesi, U. and Percoco, M. (2009). Selective migration and regional growth: Evidence from italy. http://didattica.unibocconi.it/mypage/upload/49430_20100426_125542_PERCOCO_SELECTIVE_MIGRATION.PDF.

Genovesi, G. (2010). *Storia della Scuola in Italia dal Settecento ad Oggi*. Laterza, Bari.

Giusti, F. (1965). Bilancia demografica della popolazione italiana dal 1861 al 1961. In *Annali di Statistica*, volume 17. ISTAT, Roma.

Gomellini, M. and Ó Gráda, C. (2011). Outward and inward migration in italy: A historical perspective. Banca d'Italia - Quaderni di Storia Economica, no. 8.

Gomellini, M. and Ó Gráda, C. (2013). Migrations. In Toniolo, G., editor, *The Oxford Handbook of The Italian Economy since Unification*. Oxford University Press, Oxford, New York.

Hansen, L. (1958). Large sample properties of generalised method of moment estimators. *Econometrica*, 50:1029–1954.

Harris, J. and Todaro, M. (1970). Migration, unemployment and development: A two-sector analysis. *The American Economic Review*, 60(1):126–142.

Hatton, T. and Williamson, J. (1998). *The Age of Mass Migration: Causes and Economic Impact*. Oxford University Press, New York.

Hatton, T. J. (2010). The cliometrics of international migration: a survey. *Journal of Economics Surveys*, 24(5):941–969.

Holtz-Eakin, D., Newey, W., and Rosen, H. (1988). Estimating vector autoregressions with panel data. *Econometrica*, 56:1371–1395.

Jarach, C. (1877). Inchiesta parlamentare. Ministry of Education.

Lalonde, R. and Topel, R. (1997). Economic impact of international migration and the economic performance of migrants. In Rosenzweig, M. and O., S., editors, *Handbook of Population and Family Economics*. Elsevier Science B.V., Amsterdam.

Lucas, R. (2004). International migration regimes and economic development. Report for the Expert Group on Development Issues (EGDI), Swedish Ministry of Foreign Affairs.

Matteucci, C. (1867). *Raccolti di Scritti Vari Intorno alla Istruzione Pubblica*. Tipografia Alberghetti, Prato.

Mayr, K. and Peri, G. (2008). Return migration as channel of brain drain. NBER Working Paper No. 14039.

Monteleone, S. and Torrisi, B. (2010). A micro data analysis of italy's brain drain. MPRA, Paper, no. 20995.

Mortara, G. (1913). Numeri indici dello stato e del progresso economico delle regioni italiane. *Giornale degli Economisti e Rivista di Statistica*, 47:17–29.

Mountford, A. (1997). Can a brain drain be good for growth in the source economy? *Journal of Development Economics*, 53(2):287–303.

Piras, R. (2007). Rendimento del capitale umano, qualità dell'istruzione e fuga di cervelli dal mezzogiorno. *Economia e Lavoro*, 42(2):119–138.

Sargan, J. (1958). The estimation of economic relationships using instrumental variables. *Econometrica*, 26(3):393–415.

Sargan, J. (1988). Testing for misspecification after estimation using instrumental variables. In Maasoumi, E., editor, *Contributions to Econometrics: John Denis Sargan*. Cambridge University Press, Cambridge.

Stark, O., Helmenstein, C., and Prskawetz, A. (1997). A brain gain with a brain drain. *Economics Letters*, 55(2):227–234.

Stark, O., Helmenstein, C., and Prskawetz, A. (1998). Human capital depletion, human capital formation, and migration: A blessing or a course? *Economics Letters*, 60(3):363–367.

Stock, J. and Yogo, M. (2005). Testing for weak instrument in linear iv regression. In W.K., A. and Stock, J., editors, *Identification and Inference for Econometric Models: A Fetschrift in Honor of Thomas J. Rothenberg*. Cambrige University Press, Cambrige UK.

Stolper, W. and Samuelson, P. (1941). Protection and real wages. *Review of Economic Studies*, (9):58–73.

Vecchi, G. (2011). *In Ricchezza e in Povertà: Il Benessere degli Italiani dall' Unità ad oggi*. Il Mulino, Bologna.

Villani, S. (2011). Public finance and consumption taxes (1862-1913). MPRA, Paper, no. 36856.

Williamson, J. (2006). Inequality and schooling responses to globalization forces: Lesson from history. NBER, Paper, no. 12553.

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step gmm estimators. *Journal of Econometrics*, 126(1):25–51.

Wooldridge, J. (2010). *Econometric Analysis of Cross Section and Panel Data*. M.I.T. Press, Cambridge.

Zamagni, V. (2002). L'offerta di istruzione in italia 1861-1981: Un fattore guida dello sviluppo o un ostacolo? In Gilli, G. Lupo, M. and Zilli, I., editors, *Scuola e Società. Le Istituzioni Scolastiche in Italia dall' Età Moderna al Futuro*, pages 143–182. ESI, Napoli.